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NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY

BRENT S. DRANE
Director and State Geologist

BIENNIAL REPORT

OF THE

STATE GEOLOGIST AND DIRECTOR

1923-1924

(December 1, 1922, to June 30, 1924)

NOTE.—The Survey was located at Chapel Hill during the period covered by this report

RALEIGH
Mitchell Printing Company
State Printers
1925

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LETTER OF TRANSMITTAL

Raleigh, N. C., December 30, 1924.

To His Excellency, Hon. Cameron Morrison,
Governor of North Carolina.

Sir:—I beg to submit this biennial report of the operations of the North Carolina Geological and Economic Survey for the period from December 1, 1922, to June 30, 1924. The change in the State's fiscal-year period made by the General Assembly of 1923 causes this report period to be less than a complete biennium.

Suggestions are made of the needs which have developed in the State for service required of the Survey.

A financial statement covering the expenditures of the Survey during this period is submitted.

Respectfully submitted,
Brent S. Drane,
Director.

82948

TABLE OF CONTENTS

PAGE

State Geological Board.......... 7
Officials and Employees.......... 7
Introduction 10
Administration and Records.......... 18
Forestry 22
State Forests and Parks.......... 32
Water Resources.......... 36
Geology and Mining.......... 43
Biology 45
Mapping 46
Drainage and Reclamation.......... 48
Publicity and Publications.......... 52
Financial Statement.......... 55
List of Publications.......... 56

STATE GEOLOGICAL BOARD

Governor Cameron Morrison, *Chairman, ex officio*	Raleigh
Frank R. Hewitt	Asheville
John H. Small	Washington
Dr. S. Westray Battle	Asheville
Charles C. Smoot, III	North Wilkesboro

Brent S. Drane, *Director and State Geologist*, Chapel Hill

OFFICIALS AND EMPLOYEES

(As of June 30, 1924)

Administrative Division

Brent S. Drane	Director and State Geologist
William D. Harris	Assistant to Director
Minnie Queen	Secretary to Director
Etoyal Parker	Financial Clerk
R. L. Gray	Editor "Natural Resources"
Elsie Hobby	Stenographer
R. S. Williamson	Office Assistant

Forestry Division

J. S. Holmes	State Forester
Harry Lee Baker	Assistant State Forester
Grace White	Stenographer

Carl I. Peterson	District Forester, Asheville
Mrs. Dorothy Grinnell	(part time) Stenographer

In charge of—

Buncombe County	with 11 forest wardens
Cherokee County	with 9 forest wardens
Clay County	with 7 forest wardens
Graham County	with 2 forest wardens
Haywood County	with 14 forest wardens
Henderson County	with 10 forest wardens
Jackson County	with 1 forest warden
Madison County	with 15 forest wardens
Polk County	with 7 forest wardens
Swain County	with 13 forest wardens
Transylvania County	with 7 forest wardens

FRED B. MERRILL	District Forester, Lenoir

In charge of—

Avery County	with 5 forest wardens
Burke County	with 13 forest wardens
Caldwell County	with 14 forest wardens
McDowell County	with 11 forest wardens
Mitchell County	with 2 forest wardens
Rutherford County	with 8 forest wardens
Wilkes County	with 20 forest wardens
Yancey County	with 4 forest wardens

K. E. KIMBALL	District Forester, Fayetteville
MILDRED COTTON	(part time) Stenographer

In charge of—

Beaufort County	with 4 forest wardens
Columbus County	with 9 forest wardens
Craven County	with 5 forest wardens
Cumberland County	with 9 forest wardens
Harnett County	with 4 forest wardens
Moore County	with 1 forest warden
New Hanover County	with 4 forest wardens
Pamlico County	with 6 forest wardens
Pender County	with 9 forest wardens
Robeson County	with 22 forest wardens
Sampson County	with 6 forest wardens

WATER RESOURCES DIVISION

THORNDIKE SAVILLE	(part time) Hydraulic Engineer
G. WALLACE SMITH	Assistant Engineer
L. J. HALL	Field Engineer, Asheville
J. H. MORGAN	Office Engineer, Asheville
OSCAR E. MARTIN	(for summer work) Assistant Engineer
MRS. E. T. WORKMAN	Statistician, Asheville

FIELD SURVEY PARTIES, SUMMER OF 1923

Hiwassee River Survey.—G. W. Smith, Chief of Party; D. W. Plyler, F. C. Ray, R. P. Farrell, local rodmen.

Deep River Survey.—O. E. Martin, Assistant Engineer in charge; G. A. Ausband, T. W. Cox, T. H. Andrews, C. L. Jones.

FIELD SURVEY PARTIES, SUMMER OF 1924

Dan River Survey.—O. E. Martin, Assistant Engineer in charge; G. R. McCarthy, H. C. Hart, R. G. Taylor.

GAUGE READERS

Name	*Address*
Joseph D. Bynum	General Delivery, Carboro, N. C.
C. R. Cardwell	Francisco, N. C.
G. O. Carter	Pine Hall, N. C.
Willis S. Davis	R. 1, High Point, N. C.

Name	Address
R. A. Howell	Thelma, N. C.
D. H. Jessup	Francisco, N. C.
Miss Ada Kidd	Dobson, N. C.
W. I. Greene	R. 2, Taylor's Mill, Zebulon, N. C.
Leo Kelly	Lillington, N. C.
S. U. Reynolds	431 Main St., N. Wilkesboro, N. C.
J. M. Wall	Branch, N. C.
Mrs. S. P. Wililamson	Horseshoe, N. C.
John M. Woodell	Box 24, Ramseur, N. C.
S. A. Todd	R. 2, Zebulon, N. C.
W. M. Brown	60 Ora Street, Asheville, N. C.
J. L. Clerk	Cullasaja, N. C.
J. H. Coffey	Almond, N. C.
A. H. Gillespie	Calvert, N. C.
J. T. Hayes	Tomotla, N. C.
A. D. Kilpatrick	Ranger, N. C.
Miss Mary Kinsland	Clyde, N. C.
H. H. Mashburn	Franklin, N. C.
Miss Willie Mingus	Murphy, N. C.
Mrs. Henry Miller	Warrensville, N. C.
Mrs. A. B. Osborne	Blantyre, N. C.
Mrs. U. G. Reeves	Brevard, N. C.
L. W. Roberson	776 Montford Ave., Asheville, N. C.
George W. Sheets	R. 1, Waggoner, N. C.
J. L. Walters	Cherokee, N. C.
W. D. Wike	Cullowhee, N. C.
G. A. Wilkie	Spruce Pine, N. C.
L. M. Carpenter	Spruce Pine, N. C.

Geological and Mining Division

*William F. Prouty, Ph.D	Geologist
Jasper L. Stuckey, Ph.D.	Geologist

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*Part time, 1923 and 1924.

INTRODUCTION

Ever since the creation of the State Geological Board in 1891, each biennial report which the Geological and Economic Survey has made to the General Assembly, as required by statute, has been introduced by a statement of its objects. This still seems desirable; its name fails to give a correct idea of the work assigned to it, with a resulting general misconception of it by the people who support it. The list of the duties which have been gradually assigned by statute to the Survey follows this foreword.

The original purpose was to create a board which, through the employment of a trained geologist, should discover and make known unused resources capable of producing new wealth in the State, the evident thought being of undiscovered mineral wealth. Wisely, however, their field was not so limited by statute; and it is the good fortune of the State that its State Geologists have been men of unusual economic vision. Dr. Holmes, who served from 1891 to 1904, and his successor, Dr. Pratt, who served until March 1, 1924, both recognized in our State economic handicaps, and other resources demanding intelligent use, toward which their efforts and their limited working funds could be directed with much larger and quicker returns to the State than could possibly come from their research only in geology.

In Dr. Holmes' time, an energetic and many-sided President of the United States instituted vigorous Federal leadership in policies of better highway-building and of fighting against the waste and senseless destruction of the raw resources on which our national prosperity was founded. Such support as our State Legislatures have gradually contributed through the years of educational persuasion needed to bring our people to adopt these policies, has been furnished through the Geological Board. This steady service of promotion and organization by the State Geologist preceded and has hastened the accomplishment of the State Drainage Law, under which 600,000 acres of wet land have been reclaimed, the present efficient Fisheries Commission, and the Highway Commission, which has accomplished with such monumental success the tremendous task which the State demanded of it. At the same time, through all these years the Survey, with the coöperation of the United States Geological Survey, has gradually added to, but far from completed, the exact knowledge of our mineral resources and of our water resources. Valuable records of the characteristics of the flow of our rivers (vitally necessary to the intelligent development of water-power or municipal supplies) have been accumulated; and though the present needs of the State, in its own protection, now require far more than is being done, there is proof that this past work has caused the investment in much successful power development. Finally, the vital necessity of maintaining our timber as one of the State's great sources of wealth, has been steadily stressed and urged on our public leaders; and knowledge and experience has been gathered with State and Federal coöperative funds, which prove that quick regrowth of certain species of timber is not only possible, but an economic necessity to maintain the prosperity of large areas of our State.

A study of this past record of the Survey indicates that it has necessarily been largely the expression of the views and the ability of the State Geologist, and it is inevitable that its work has been thought of in terms of his personality. We believe that the record of results attained substantiates the good judgment with which past boards have apportioned the use of their limited working funds, and we hope that the record of the results of the past nineteen months covered by this report shows corresponding returns from the use of the current appropriation, the most generous ever made to the Survey.

Above everything else, however, it is our earnest desire in this report to impress on the General Assembly our conviction of the immediate needs of the State for more adequate measures toward preserving certain essential industries, as detailed hereinafter; and particularly our conviction of the urgent need by industry and commerce in the State for thorough and complete knowledge of the essential conditions which determine our economic status, namely, an economic survey in fact and not in name only. Such a service, to fully meet the many needs for it which have grown in the State, is beyond the capacity of any existing department or board as now organized in the State; and it is certainly beyond the capacity of any individual officer or employee of the State to interpret so complex a mass of statistical knowledge with authority enough greatly to affect public policy.

These needs for such service have grown so rapidly within recent years as, perhaps, to justify a brief review of our changing conditions. Foremost of all is the advance of our standard of living, resulting, as intended, from the State's large investments in public education, health, welfare, and highways. These, while creating larger demands by our people, are designed equally to create in our people the ability and the will for the greater production necessary to earn what is required to satisfy new demands. In so far as can be done without socialistic or paternalistic leanings, sound public policy should furnish such a service of information on controlling conditions and tendencies, as to safeguard to our people all opportunities for increased earning to which our State is adapted.

Land-use is waning, partly from more intensive working of smaller farms, partly from abandonment of farms for industry, but most of all from the nonreplacement of timber growth on vast areas whose lumber industry has largely supported rural areas. Nonproducing land is increasing at a rate far more rapid than that of population in the United States, on which larger demand for agricultural production must depend. The single recent great new market for our agriculture has been created by the phenomenal growth of the cigarette industry.

In commerce, it has recently been exhibited to our people what handicaps our State labors under; but even with such remedies as we shall surely apply, commerce will probably not quickly enlarge greatly the annual distribution of new wealth in a population like ours, three-fourths rural. Our first need is for greater returns from the average man's production.

In industry is found the source of our great forward strides in earning power during the last two decades; both from its supplying needed direction and markets for capable industrial workers who came from hopeless agriculture, and from the improved local markets these workers made for the produce of remaining agricultural workers. A similar continued movement toward economic balance in our earning conditions in the State is evidently most desirable. This involves the condition of increasingly keen competition between our manufacturers and those of other States and other nationalities, and brings in an increasing consideration of world conditions. Our past success as a nation in selling our manufactured products has been based on our enormous wealth of cheaply transported raw materials and our genius in developing the organization and the mechanical processes of production. Other nations have generally surpassed us in the popularity of their salesmanship in foreign markets. At present there appear to be tendencies promising even keener competition. Both the recent profound disturbances in international finance and our restrictions on immigration from foreign nations have adversely affected our popularity; it is possible that for some time equal consideration of our manufactured products in foreign markets may largely be confined to those controlled by financial groups so strong that their will in world politics and commerce cannot be ignored. At the same time our raw resources, prodigally used, are in some instances dwindling and requiring more transportation cost, and our national standards of living keep our labor costs on the increase;

while, on the other hand, other nations, content with a scale of living immeasurably lower than ours, and working long hours for incredibly low wages, are successfully adopting our machinery and methods of organization, making cheaper both in manufacturing and in agriculture their already cheap production.

Under these conditions, evidently, competition among our states for marketing advantage, both in agriculture and in industry, must become keener. The greatest concentration of the world's wealth is now in this country; competition for its distribution will be world-wide. Still an agricultural State, we have hardly yet begun to enter this competition, necessary to balance up our economic structure and make us self-supporting in our higher standard of living requirements. In the past, such outside capital as has been attracted to us has largely been engaged in exploiting destructively our natural resources; and the end of this process is already in sight. A great duty, therefore, rests on the State to inventory and appraise so fully its resources, both natural, human, and cultural, as to enable our own people to see clearly wherein our interest lies and shape our policies accordingly. Capital does not recognize State lines, nor even national lines.

In the Federal Government several agencies, which have long been intelligently working with an eye to maintaining the sources of our national advantage, have tried, through their research and experience, to prove to our state governments the need of using our natural resources with the same far-sighted business acumen that older countries have developed through centuries of necessity. Where states have declined to take adequate action, Federal powers have increased, and tend to ignore state lines. In our own case it can be proven that we are in danger of surrendering advantages which we can never regain, and of losing direction of some of our most valuable resources. We can maintain our advantage only when our leaders of public thought thoroughly understand existing conditions and their far-reaching consequences. These involve so many highly technical aspects, unfamiliar to ordinary business experience, that the agency safeguarding the State's interests must not only be technically expert and provided with the means to make thorough findings of the facts, but, beyond that, its personnel must be such as to command the thorough confidence of our leaders in government.

Such an economic survey, to gather with sound discrimination, out of the multitude of statistics which might be gathered, only those which are of real significance, demands technical training of a high order. It should be done in an expert and authoritative way, or not at all; superficial conclusions from partially ascertained facts might work infinite harm. The State would probably not give a moment's consideration to employing, at their necessary cost for full-time service, a group of business statisticians and analysts of national reputation, such as private business of size and importance comparable with that of the State, does employ. Fortunately we have already in the State's employ, in our institutions of higher learning, and in various departments of the State, a number of men who, each in his own field, are nationally recognized as experts. By providing an agency into which can be brought together the joint investigations of such men, using a portion of their time, each in his own field of study, simultaneously on the problems of one and the same area, it is possible to secure for various typical representative areas of North Carolina an economic survey by experts in which all aspects are covered, and in the course of which their differences of viewpoint and opinion might be reconciled into a joint series of conclusions. After this expert study and analysis, a further review should be provided by the directing board of the agency, who should be citizens appointed by the Governor for outstanding qualities of recognition for business acumen, knowledge of North Carolina people, and unquestionable fidelity to the State's interest. Such a study, reviewed by such a board, can be the means of guiding the development of the State, in so far as public policy could apply, along the direction of the fewest costly errors and of most lasting gain.

In the review of conditions just made, there is no possible ground for pessimism as to the sureness of North Carolina's continued progress. It is desired only to point out that we must enter into an increasingly keen competition for every enduring advantage. Well-chosen immigration is one of our needs; yet we must recognize the fact that in those very areas from which we would prefer to draw new land-users, not only their own states are striving by all means to hold them, but other near-by states are exerting their best intelligence to attract them. In certain of the middle-northern states the problem of abandoned land is acute to a degree we do not yet conceive of, with many counties receiving much larger appropriations from the state treasury than they pay into it, and large areas of land reverting to the State through foreclosure for unpaid taxes. These states are strenuously engaged in appraising their resources so as to give all possible help in guarding against wastage of their human values. We are not alone among Southern States in our needs; and other Southern States will ably contest with us in offering assurance of prosperity to the kind of land-users we desire to attract. Our great concern is to settle in our State producers who will prosper, and not land-buyers foredoomed to failure. The State can safeguard the enduring character of its citizenship only by a thorough service of reliable information on actual conditions in our State on which successful land-use depends, or on which successful manufacturing enterprises must be based.

One of our greatest past handicaps in attracting desirable new citizenship has been overcome by our recent contributions to community life in better roads, schools, and public health. The magnificent way in which we have quickly caught up with, and in some instances even surpassed the standards to which more developed regions have become accustomed, has caught the appreciative interest of other states, and given North Carolina real news value. While much of the attractive magazine writing has been done by men who do not know North Carolina, and is therefore superficial, its potential value has been enormous, in that a passing interest has been excited among many thousands of readers who never before had thought of our State. But we should have the sober judgment to realize that news value of this sort is a fleeting thing and that the fad among feature-writers of giving our State free praise will soon pass. If we ourselves do not quickly build upon this foundation, its value will be largely lost to us. The follow-up campaign of advertising of our State, if it is to attract solid new citizenship and add solidity to our prosperity, must be based on a service of information in detail and of authority demanded by the prudent business man and investor. No agency of the State is now capable of providing such service; several State agencies provide fragments of it; but neither our own statesmen for their own service to the State, our local chambers of commerce or realtors concerned in permanently upbuilding their communities, nor the thoroughly interested prospective investor, manufacturer, or settler can obtain promptly the full service of authoritative information which he needs to convince him that his investment is safeguarded—information not only on what we have done, but on what he, with energy and capital, can do.

This service is needed now; much of the basic information needed to enter into a full analysis of how far our State can satisfy some requirements has not yet been gathered; and working time and the services of competent technical experts must be had before it is available. The State cannot afford to delay this undertaking.

On the following pages are set out the work done since our last report and up to June 30, 1924, in each department of the Survey, and our judgment of the immediate needs of each, to bring its service up to the requirements which present conditions in the State demand. They include provision for our needs in conservation, to promote our continued revenue in the State from our natural resources, subject to alienation or needless extinction; and in development, for which a prime necessity is the adequate economic survey above discussed.

That these services fall within the duties of this board is indicated by the following compilation of the statutory requirements of it:

1[1]. An examination of the mineral, forest, fishery, and other material resources of the State.
2[1]. An examination of the geological formations of the State with reference to their economic products.
3[1]. An examination of the road-building materials and the best methods of utilizing same.
4[1]. An examination and classification of the soils, the forests, and other physical features of the State, with special reference to their bearing upon the occupation of the people.
5[1]. An examination of the streams and water powers of the State, with special reference to the development for manufacturing enterprises and the preservation of the sources of these streams through the protection of the forests.
6[1]. The consideration of such other scientific and economic problems as in the judgment of the geological board shall be deemed of value to the people of the State.
7[1]. The preparation of such reports, illustrations, and maps as may be deemed necessary in placing the results of these investigations before the public.
8[1]. And the State Geologist, with the approval of the Geological Board, is hereby authorized to arrange for and accept such aid and coöperation from the several United States Government bureaus and other sources as may assist in completing the topographic surveys of the State and in carrying out other provisions of this chapter.
9[1]. An examination of the water supplies of the State, with special reference to the sinking of deep or artesian wells.
10[2]. To collect such data and publish such reports as will lead to a more economic and efficient road-building policy for the State, and to assist in the educational side of road work by the holding of road institutes, conventions, and through the publication and distribution of literature relating to road supplies and road building.
11[3]. To work out plans and ways and means for the reclamation of the vast swamp and overflowed areas of the State and the utilization of these very rich black soils when reclaimed.
12[4]. To protect and conserve the forests of the State and to administer the forest fire law passed by the General Assemblies of 1915, 1919, and 1921.
13[5]. To administer State forests, and to use same so as to demonstrate the practical utility of timber culture, water conservation, and their use as refuges for game.

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[1] Consolidated Statutes, Vol. 2, 1919, chapter 101, section 1621.
[2] Consolidated Statutes, Vol. 2, 1919, chapter 101, section 6123.
[3] Consolidated Statutes, Vol. 2, 1919, chapter 94, article 5, section 5417.
[4] Consolidated Statutes, Vol. 2, 1919, chapter 101, article 5; Public Laws of 1921, chapter 26.
[5] Consolidated Statutes, Vol. 2, 1919, chapter 101, article 3.

14[6]. To coöperate with counties in the protection of their forests from fire, and in the development of their natural resources.

15[7]. To assist in the establishment and organization of agricultural development districts.

16[8]. To coöperate with the Federal Power Commission in the carrying out of rules and regulations promulgated by that Commission; and to act on behalf of the State in carrying out any regulations that may be passed relating to water powers in North Carolina other than those relating to making and regulating rates.

17[9]. To coöperate with the North Carolina Corporation Commission in investigating the water-power situation in North Carolina, and to furnish said Commission with information regarding location of water-power sites in the State, developed water powers, etc.

18[10]. To administer and protect Mount Mitchell State Park.

19[11]. To advertise the natural resources of the State through illustrated publications, maps and lectures.

20. To coöperate with other State bureaus in making investigations and publishing data in connection with the working out of certain State problems.

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[6] Public Laws of 1921, chapter 26.
[7] Consolidated Statutes, Vol. 2, 1919, chapter 85, section 4693.
[8] Public Laws of 1921, chapter 138, section 1.
[9] Public Laws of 1921, chapter 138, section 2.
[10] Public Laws of 1921, chapter 222.
[11] Consolidated Statutes, Vol. 2, 1919, chapter 101, article 1, section 6122; and article 2.

ADMINISTRATION AND RECORDS

Brent S. Drane, *Director*

Under this division, the office of the Director of the Survey, following out policies approved by the State Geological Board, apportions expenditures among the several divisions of the work, and gives general direction governing the work in each. In addition, the Director has hitherto personally directed work coming under the divisions of mapping, drainage and reclamation, and publications and publicity.

On March 1, 1924, Col. Joseph Hyde Pratt, for twenty years Director of the Survey, resigned to devote his full time to the development work of Western North Carolina, Incorporated. The present report, therefore, covers a period of fifteen months prior to that date under Colonel Pratt's directorship, and four subsequent months under the present Director. The splendid record of accomplishment in so many fields of progress which must be credited to Colonel Pratt's vision, energy, and ability through his long term of service makes proper the entry here of the following official references, for their publication in this permanent published record.

Resolution adopted by State Geological Board, February 1, 1924:

> Whereas Col. Joseph Hyde Pratt has tendered to the Governor his resignation as State Geologist, to be effective March 1, 1924, and
>
> Whereas Colonel Pratt has held the position of State Geologist for a period of about nineteen years; and, incidentally, Mr. Frank R. Hewitt, a member of this board, has served for the same period, and he and the other members of the board are familiar with the activities and services of Colonel Pratt: Now, therefore,
>
> *Resolved*, That the board make public recognition of the invaluable services rendered to the State by Colonel Pratt: He has been loyal, industrious, and effective in the investigation of the natural resources of the State, and in giving them publicity and in devising plans by which they might be utilized for the upbuilding and the progress of the State. Many new industries have been established and nonresidents have been attracted and have united their wealth and energies with those of the people of the State. In all those activities in which Federal coöperation has been available, he has been unusually successful in securing both expert and financial aid from the Federal Government. Altogether, Colonel Pratt has made an enviable record of service, which should be a source of gratification to him, and which should earn for him unstinted recognition and gratitude from the people of North Carolina.
>
> *Resolved*, That the board regret exceedingly the resignation of Colonel Pratt, and wish for him personally and professionally good health, happiness, and prosperity in any further work which he may undertake.
>
> *Resolved further*, That a copy of this resolution be spread upon the minutes, and that the secretary to the Director be directed to deliver a certified copy thereof to Colonel Pratt, and also furnish a copy to the press of the State.

Colonel Pratt's attainments were recognized and drawn on through many agencies whose work was allied to that of the Geological and Economic Survey; in 1923 his report mentions such official service as follows: President of the Southern Appalachian Power Conference, and of the North Carolina Conference for Social Service; chairman of the Executive Committee of the Southern Forestry Congress; vice-president of the North Carolina Agricultural Society; member of Executive Committee of North Carolina Forestry Association; secretary-treasurer of North Carolina Drainage Association; and director in the Made-in-Carolinas Exposition, the American Forestry Association, the National Drainage Congress, and the Mississippi Valley Association.

These active contacts were encouraged by the board, as contributing largely to the prestige of the North Carolina Geological and Economic Survey among Southern States, and consequently with our coöperating agencies in the Federal Government. During the year 1923 the reports of the Director cover one hundred and forty-five conferences, within and outside of the State, on work of the Survey and such allied southern agencies. During that year the Director was largely instrumental in the success of the meetings of the Southern Appalachian Water Power Conference at Asheville, N. C., June 25-27, of the United States Senate Committee on Reforestation at its hearing at Asheville, November 15-16, 1923, and of the Forestry, Reclamation, and Home-Making Conference at New Orleans, November 19-22, 1923; and of the meeting of the Southern Forestry Congress at Savannah, Ga., January 28 to 30, 1924.

Since March 1, 1924, the present Director has taken part in the programs of North Carolina Drainage Association at Belhaven, N. C., April 30; of the North Carolina Association of Commercial Secretaries at New Bern and Morehead City, N. C., June 27; and of the American Society of Civil Engineers in Atlanta, Ga., April 11 and 12.

The foreword mentions the wide scope of matters promising economic possibilities, which the Directors of the Survey have in the past undertaken to foster. In 1923 Colonel Pratt made special trips and reports in connection with the proposed stocking of Holt Lake, Johnston County, with game fish; and with the plans of General Bowley, in command of Fort Bragg, in Hoke County, for the protection of the forests of the military reservation and their use as a game preserve.

On November 1, 1923, Maj. William D. Harris entered the employ of the Survey as assistant to the Director, and in addition to relieving the Director of some routine matters, made a field trip in January, 1924, reviewing the status of drainage projects in the State.

Under the present Director, his particular assignment has been to improving the Survey's reference system to its library and other records, and to studying and reporting on ways and means of bringing the

Survey's service of information into wider usefulness. This work has included the installation of exhibits at expositions and fairs within the State, at which, by personal attendance, new contacts are made which broaden the Survey's contributions of service and educational work.

During the four months of the present Director's incumbency, which are covered by this report, the whole effort has been to arrive at some standards of attainment, by which to judge of the effectiveness of the work of the Survey's organization; to appraise correctly the points within the field of service assigned by statute to the Survey, at which important needs were not being met, and to strengthen the organization at these points. From this standpoint, after thorough consideration of available men, Mr. Jasper L. Stuckey, Ph.D., was employed as Geologist, to report July 1, 1924, and Mr. Harry L. Baker was employed as Assistant State Forester, reporting for service June 15, 1924; the work for which they are employed is particularly mentioned hereinafter under their respective divisions.

The foreword has outlined our conviction of the need of promptly organizing an economic survey of the State. We believe that exceptional breadth of mind and zeal for constructive service is characteristic of the workers in the several departments and institutions, whose part in such a coöperative undertaking is essential; and that such cooperation is entirely practical. The program and scope of such an economic survey should be determined in joint counsel of such a group, prior to the division among themselves of the portion of the study each is to undertake.

The expenditures under this Division have been as follows:

ADMINISTRATIVE

Disbursements for Biennial Period Ending June 30, 1924

Director's salary	$9,500.00
Salaries—personnel	10,880.87
Expenses—Director and personnel	3,014.81
Clerks, temporary assistants, etc.	1,588.91
Postage	2,581.00
Office supplies	2,081.96
Equipment (for all divisions)	8,410.05
Telephone and telegraph	524.04
Freight, drayage and express	558.72
Fairs, publicity and exhibits	1,267.81
Rent on storeroom	233.32
Board meetings—per diem and expenses	176.20
Miscellaneous	1,102.03
Drafting	4.40
Box rent	5.25
	$41,929.37

The estimated needs of this division for the fiscal years 1925 and 1926, to include the expanded economic survey and service to commerce, manufacturing, and industry, are as follows:

COST ESTIMATES FOR THE BIENNIUM BEGINNING JULY 1, 1925

ADMINISTRATIVE DIVISION

	Requested Estimated Needs	
	1925	*1926*
Personal service	$28,120	$28,900
Supplies and materials	1,900	1,900
Postage, telephone and express	2,800	2,800
Travel expense	6,000	6,000
Printing, binding, and publicity	2,500	2,500
Light, power, and water	50	50
Repairs	100	100
General expense	1,500	1,500
Equipment	1,200	1,200
	$44,170	$44,950

FORESTRY

It is not often appreciated how great a part the forests of North Carolina have played in producing the present capital wealth of the State. The indifference of the average citizen to their rapid decline is proof that he does not realize how dependent our agricultural population still are on forests for turning their surplus labor into income, and how great is the total annual wealth produced by the industries forest products support.

At the present time it is estimated that only the State's textile industry (producing $230,000,000 annually, raw material value included), and tobacco industry (producing $215,000,000 annually, raw material value included), exceed the $168,000,000 per year of new wealth from our forests.

The estimate, made from a survey of forest conditions in 1920, that our cutting is proceeding at a rate double that of our reproduction, and that this continued process will spell the end of our lumber industry (as completely as that of our former naval stores industry of former years) within a period of twenty years, indicates a steady shrinkage of annual income at an enormous rate, and an approaching condition which will mean disaster to many rural areas if the tide is not turned.

Experience to guide us in changing this condition and making our forests permanent and steady producers, is abundant. It is necessary first to bring our people to realize the absolute necessity of maintaining this great source of employment and revenue. Following that, they will follow the experience of other states (and other nations) and either help Nature to produce a new timber crop on land otherwise useless, or at least not hinder Nature as at present.

For natural reproduction only two things are needed, to leave seed trees of desirable species, and to protect the new growth from destruction by fire or hogs and cattle. Where natural reseeding is at an end and all new growth of valuable species is killed, only artificial replanting remains. Relatively little of the latter, as compared with giving Nature a chance, is needed in North Carolina; it is interesting to note one instance of artificial planting, however. Whereas our State was once noted for "tar, pitch, and turpentine," and now produces practically none, the world's greatest naval-stores district is now in Southern France, from forests planted on what were formerly treeless sand dunes and salt marshes. Their resin and lumber are cropped as regularly and permanently as fruit from an orchard, by a population living in permanent villages. The contrast of our former long-leaf pine areas with this is a challenge to our pride and self-respect.

The methods of the lumbering industry are destructive all over the Nation; but they are induced by keen competition. North Carolina pine competes in a market often glutted by Pacific redwood. Our lumbermen are fully up to the standard of good citizenship of our other business men, and they may be counted on to adapt themselves to sound public policy as soon as the general public opinion sets up and supports such a policy.

North Carolina is late in entering on a State policy of maintaining its forest wealth on a basis of steady and permanent production. The following table shows the progress of appropriations for forest maintenance.

STATE EXPENDITURES FOR FOREST FIRE PROTECTION, 1915 TO 1924

Year	State	County	Association and Private	Federal	Total	Approximate Percentage Paid by State
1915	$ 1,707.35	$	$ 253.57 Assn.	$ 379.33	$ 2,086.68	82
1916	1,068.49		133.97 "	699.67	1,768.16	60.5
1917	1,137.00		591.52 "	657.66	1,794.66	56.5
1918	2,267.79		137.52 "	1,238.00	3,505.79	64.5
1919	2,049.98		160.23 "	1,468.53	3,518.51	58.2
1920	4,132.52		466.31 Pri.	1,943.17	6,075.69	68
1921	5,593.51	350.00	177.60 "	5,112.43	10,705.94	52.3
1922	12,618.25	950.82	134.12 "	12,618.20	25,236.45	50
1923	13,736.65	3,479.48	184.55 "	10,715.93	24,452.58	56.2
1924	29,963.43	4,628.15	115.49 "	22,604.14	52,567.57	57

Though the current report officially covers only to June 30, 1924, its delayed publication makes possible these figures for the full year 1924, which are published for comparison.

The total area needing protection is estimated at 19,500,000 acres, from which the present State appropriation is seen to be at the rate of $0.0015 per acre. The United States Forest Service, from its experience in the National Forests in the State, estimate a cost of $0.0255 per acre annually for the complete protection of our North Carolina forest growth.

It is interesting to compare with this the figures in the following table, which show the comparatively greater seriousness with which forest maintenance is considered by other states, in which the ecnomic pinch has been more keenly felt.

Present State Coöperation with United States Forest Service in Fire Protection Work

State	Area Needing Protection, Acres	Estimated Cost per Acre	Estimated Total for Full Protection	State Appropriation Available	Per Acre
South Dakota	50,000	$ 0.03	$ 1,500	$ 7,140	$ 0.143
New Jersey	1,800,000	.04	72,000	75,925	.042
Rhode Island	250,000	.035	8,750	6,310	.025
Massachusetts	3,000,000	.04	120,000	62,000	.021
Pennsylvania	13,000,000	.03	390,000	228,375	.0175
Michigan	15,000,000	.03	450,000	241,000	.0161
New York	14,000,000	.028	392,000	173,540	.0124
Connecticut	1,500,000	.03	45,000	19,115	.0122
New Hampshire	4,300,000	.028	120,400	48,425	.0113
Maine	15,000,000	.028	420,000	165,500	.0110
Minnesota	20,000,000	.035	700,000	194,600	.0097
Ohio	1,150,000	.02	23,000	11,000	.0095
Idaho (North)	3,750,000	.08	300,000	33,500	.0089
Maryland	2,200,000	.025	55,000	11,110	.0050
West Virginia	6,000,000	.025	150,000	28,690	.0047
California	13,000,000	.025	325,000	61,750	.0047
Idaho (South)	1,100,000	.03	33,000	4,600	.0042
Oregon	12,000,000	.03	360,000	47,705	.0040
Louisiana	12,000,000	.025	300,000	40,000	.0033
Montana	4,900,000	.04	196,000	16,000	.0032
Washington	12,000,000	.03	360,000	30,065	.0025
Wisconsin	14,000,000	.03	420,000	23,000	.0016
New Mexico	1,200,000	.01	12,000	1,960	.0016
Texas	11,000,000	.025	275,000	18,000	.0016
Vermont	3,750,000	.016	60,000	6,000	.0016
North Carolina	**19,500,000**	**.025**	**487,500**	**30,500**	**.0015**
Alabama	20,000,000	.025	500,000	30,000	.0015
Virginia	14,000,000	.025	350,000	19,875	.0014
Kentucky	7,500,000	.0225	168,750	10,000	.0013
Tennessee	9,000,000	.0225	202,500	11,700	.0013

In the past, the very small State appropriations available in the earlier years allowed of no more than a series of studies of actual conditions in the State, including studies of rates of growth and the most important species to be depended on to make a reforestation program most profitable. These studies have been published and made the basis of educational work by bringing them to the attention of each General Assembly and of our people concerned in the lumber industry. The North Carolina Forestry Association, made up of citizens interested in the subject, has been an agency fostered by the Survey for many years, and its meetings have helped to spread the knowledge of conditions and their needs.

The only possible means of spreading a realization of the practical needs of forest maintenance and the practical means of meeting the needs, so that any prompt results will be got, is by converting the man on the land. In many cases he is illiterate; the tenant farmer, white or negro, is as vitally necessary in coöperation as is the more enlightened landowner. He cannot be reached by the printed page or by speechmaking. Personal contact and gradual conversion is necessary. This is possible only through a neighbor-to-neighbor method of approach.

The need is to make the man on the land care something about the woods. Law enforcement officers are necessary, but they alone cannot effect this quickly; laws that interfere with old habits of thought are hard to enforce. A forest-ranger organization, corresponding to a city fire department, of full-time employees held at headquarters until the fire alarm is given, cannot make these persuasive contacts most effectively.

For this reason we have adopted the forest-warden system, whereby men living on the land, at distances apart averaging about two miles, are employed for only such time (on an hourly basis) as their services are needed for gathering fire-fighters and extinguishing fires in their localities, and for spreading the gospel of care of the woods. These men are given special instruction and oversight by a county warden in each organized county, and these are under the direction of a district forester. This work heads up under the Assistant State Forester.

This system, long urged by this Survey, was only made possible, on a scale that could be called an adequate beginning, by the appropriations of the General Assembly of 1923, the results of which are given in this report.

The work, with the exception of that of a few wardens required by unusual conditions, has been confined to counties which have coöperated with the State in bearing the cost of the fire-fighting. This policy has been adopted for two reasons: first, that with so enormous an area needing protection, the limited State funds should be spent where they would go farthest, by the addition of local coöperation; and, no less important, that where a county is contributing its own funds to the work, public interest and support is far more thorough.

The present organization is outlined in the list of the personnel earlier in this report. The extension of the organization is shown in the following table:

Growth of Forest Fire Protective Organization

	Dec. 1, 1922	June 30, 1923	Dec. 31, 1923	June 30, 1924
District foresters	2	2	3	3
Counties coöperating	21	22	25	25
County wardens	------------	19	22	25
District wardens	145	212	220	231
Deputy wardens	------------	198	486	1,100

At the beginning of this period the warden organization was headed by Mr. W. Darrow Clark and two assistants. Mr. Clark was doing excellent work in organization, when his untimely death occurred on March 17, 1923. One of his assistants was found not to be adapted to the work, and let go. Of this organization has remained Mr. Fred B. Merrill, district forester in charge of District 2. On August 1, 1923, Mr. Carl I. Peterson entered the Survey as district forester in charge of District 1, at Asheville; and December 3, 1923, Mr. K. E. Kimball was secured to take charge of District 3, comprising the southeastern cooperating counties. General direction of the work remained with the State Forester until June 15, 1924, when Mr. Harry L. Baker was employed as Assistant State Forester, to be in full charge of the fire-protective organization. All of these men came to the Survey with an excellent record of training and successful experience, and they form the directing heads of an organization which will show increasingly effective results.

The weakest point in this plan of organization is in the county warden. It is very hard to secure men of the necessary qualities of character, ability, and acquaintanceship in their counties, who for the small hourly wages allowable by State law can afford to give the time from their own affairs to keep closely in touch with the wardens under them. Constant improvement in interest is noted, however, and a growth in effectiveness throughout. A number of individual county and district wardens have so genuinely put their ability into the work as to secure remarkable examples of what can be accomplished under able local leadership.

The following table (No. 4) contains a summary of reports of forest fires through the years listed. Where there is no warden organization, the report is based on replies to questionnaires mailed out from this office from voluntary correspondents in various parts of the State. Such responses do not give a complete record, and careful judgment is necessary in estimating from the partial reports received the probable figures for each county and for the State as a whole. In this table no estimates are included, but the results of actual reports are tabulated.

TABLE No. 4

FIRE STATISTICS, ENTIRE STATE OF NORTH CAROLINA, 1909 TO 1923

Year	Number Fires Reported	Area Burned, in Acres	Damage in Dollars	Size of Average Fire in Acres	Average Damage per Fire in Dollars	Average Damage per Acre in Dollars
1909	607	406,065	$ 252,404	667	$ 439	$ 0.66
1910	706	579,553	526,990	821	775	.97
1911	637	160,225	448,700	250	705	2.80
1912	665	616,051	1,089,784	926	1,639	1.76
1913	551	323,444	706,209	587	1,282	2.18
1914	669	295,000	600,000	462	939	2.03
1915	1,151	412,000	495,000	303	445	1.30
1916	2,212	977,000	3,640,000	442	1,646	3.60
1917	1,833	128,000	673,000	69	367	5.18
1918	1,136	204,000	856,000	180	753	4.20
1919	1,359	253,000	1,255,000	181	923	4.56
1920	1,607	190,000	1,258,000	119	783	6.63
1921	1,632	271,430	1,093,000	166	666	4.01
1922	1,227	180,737	639,000	147	521	3.54
1923	1,308	269,000	820,000	206	627	3.04
Totals	17,300	5,265,505	14,353,087			
Averages	1,153	351,034	956,872	304	821	2.70

The data for the years 1909 to 1920, inclusive, was obtained from reports submitted by volunteer fire correspondents only; it is estimated that the average reported damage was about 75 per cent of the actual damage. The State had warden organizations in four counties in 1921, sixteen counties in 1922, and twenty-two in 1923. Information obtained from forest warden reports for these coöperating counties was supplemented by the reports from volunteer correspondents and the return for these years is estimated at about 80 per cent complete.

The county and district forest wardens are empowered to prosecute violations of the State forest-fire laws. Careful effort has been made to direct this work with even justice and in such a manner as to develop understanding of the law and respect for it, and to return from prosecution where evidence is insufficient for conviction. It is our belief that constant improvement is observed under this policy. The record of prosecutions during the period of this report is as follows:

RECORD OF FIRE LAW PROSECUTIONS, COVERING ENTIRE CALENDAR YEAR, JANUARY 1, 1923, TO JANUARY 1, 1924

DISTRICT NO. 1

County	Number of Cases	Reporting Officer	Convictions	Acquittals	Total Fines	Total Costs Assessed
Cherokee	1	H. N. Taylor		1	$	$
Jackson	1	C. G. Rogers	1		10.00	20.00
Transylvania	1	W. J. Owen		1		
Swain	1	R. H. McMahan	1		10.00	Costs

No prosecutions reported by other three districts.

RECORD OF FIRE LAW PROSECUTIONS, JANUARY 1, 1924, TO JUNE 30, 1924

DISTRICT NO. 1

County	Number of Cases	Reporting Officer	Convictions	Acquittals	Total Fines	Total Costs Assessed
Buncombe	3	W. E. Fletcher	3		$ 30.00	Costs
Haywood	2	P. B. Phillips	2			$ 9.60
Henderson	2	W. F. Cathey	1	1		9.00
Cherokee	1	H. N. Taylor		1		
Swain	2	L. M. DeHart and Ras Duvall	2		10.00	5.05
Totals	10		8	2	40.00	23.65

DISTRICT NO. 2

County	Number of Cases	Reporting Officer	Convictions	Acquittals	Total Fines	Total Costs Assessed
Burke	1	J. H. Parks	1		$	$ 51.30
McDowell	8	George Rhom, D. G. Brown, M. R. Nanney, J. L. Waters	8		10.00	81.02
Wilkes	1	G. C. Parsons	1		10.00	Costs
Totals	10		10		20.00	132.32

DISTRICT NO. 3

County	Number of Cases	Reporting Officer	Convictions	Acquittals	Total Fines	Total Costs Assessed
Columbus	2	Minos Mears	2		$ 30.00	$ 7.25
Cumberland	1	K. E. Kimball	1		10.00	24.60
Pender	4	Erle McKoy and Jim Black	1	3	10.00	12.00
Robeson	1	Lacy McNair, J. S. Darden, R. M. Pearson	1		25.00	Costs
Sampson	10	A. H. Strickland, J. L. Underwood	10		100.00	91.15
Totals	18		15	3	175.00	135.00

DISTRICT NO. 4

County	Number of Cases	Reporting Officer	Convictions	Acquittals	Total Fines	Total Costs Assessed
Craven	10	Carter Tisdale	10		Record in	complete
Pamlico	3	H. Z. Swindell and B. D. Banks	3		$ 20.00	$ 4.95
Totals	13		13		20.00	4.95
Grand totals	51		46	5	255.00	295.92

Three examinations and reports to landowners giving advice on reforestation were made by the State Forester in 1923. It has become evident that stock for replanting barren areas is either not obtainable at all or, where available, cannot be had at prices permitting general use. The Survey has in the past urged the necessity of one or more tree nurseries for the production of seedlings and planting stock, as part of the State's program of aiding reforesting barren areas, stock to be sold at cost. Several years will be required to bring these up to production after they are established. These should not be further delayed.

The fire-protective organization puts great stress on educational work for fire prevention, and not simply fire-fighting. This work includes addresses, news articles (based preferably on local studies of conditions), and contacts with the schools. Meetings of wardens have been held in each district for the purpose of instruction and demonstration of methods, both of education and in the use of special fire-fighting tools. Of the latter, the Survey was enabled to lay in a good supply during June, 1924, with the balance of the Federal coöperation fund, which would otherwise have lapsed.

The former Director and the State Forester have been for many years active in the promotion of forestry throughout the South. In addition to taking active part in the program of the North Carolina Forestry Association at Pinehurst, N. C., in 1923, and at Washington, N. C., in 1924, they have both been active in the program of the Southern Forestry Congress at Montgomery, Ala., in January, 1923, and in Savannah, Ga., in January, 1924; at the latter meeting the State Forester, Mr. Holmes, was elected President for the current year. Other agencies in which they have been active have been the Appalachian Logging Congress, and the Southern Appalachian Water Power Conference; the State Forester, as chairman of the Committee on Forestry and Watershed Protection has contributed to their meetings.

During the period covered by this report, much of the time of the State Forester has been required on organization and records. Important studies in which he had the coöperation of the Southern Appalachian Forest Experiment Station of the United States Forest Service, at Asheville, have been made in the field on white cedar (juniper), and on the chestnut blight. In providing funds for the latter study, the Director of the Survey in 1923 made an effort to secure private coöperation, without success, and brought the matter to the attention of the Secretary of Agriculture.

The carefully considered result of the study of the chestnut blight is the conclusion that no hope of checking its advance can be held; and that present attention should be directed solely to the use of existing stands of chestnut before they are rendered worthless by the disease. Studies of the species which are replacing the chestnut in the areas farther north, which have been ravaged, indicates that a healthy growth of valuable hardwoods is everywhere in evidence.

The expenditures in this division, and including those on account of Mount Mitchell State Park, are detailed as follows:

FORESTRY DIVISION

Disbursements for Biennial Period Ending June 30, 1924

State Forester's salary	$4,750.00
State Forester's expenses	1,485.16
Chief Forest Warden's salary	950.00
Chief Forest Warden's expenses	293.60
District foresters' salaries	7,225.00
District foresters' expenses	4,746.54
Stenographer's salary	1,670.00
Forest wardens' services and expenses	13,119.74
Fire fighting	9,027.96
Mount Mitchell—including warden's salary	3,387.94
	$46,655.94

The conditions demand a prompt enlargement of this work to save excessive losses to the State. The policy outlined below is carefully considered, and can quickly be put into effect on a sound basis. After two years of its operation, more intensive advance in artificial reforestation should be made. We urge this as a minimum for immediate adoption; none of it can be deferred without loss of critical time.

1. Reforestation:
   - a. Aid Nature's efforts; stop the killing of seedlings and young forests by fire. This requires a complete forest warden organization in 40 counties at once, and a skeleton forest warden organization in 40 more counties. This will require one additional district forester with office and clerk, and the appropriation for additional wardens' and fighters' wages and tools and equipment; and two more clerks in the main office.
   - b. Establish in 1925 one Mountain tree-nursery; establish in 1926 a Piedmont-Coastal tree-nursery. The planting stock needed cannot be bought. The State must grow it. This calls for land and buildings, a nursery man and labor for each; and one planting specialist to extend planting on State Forests and Parks and on private lands which pay the cost.

2. Forest Improvement:
    a. Extend detailed study and investigations in land classification for species, in rates of growth and yield, in existing and possible new forest resources, in taxation relationships, and in markets and marketing methods.
    b. Give service to small landowners in demonstrating improvement of growing forests and in helping to organize coöperative marketing where needed. This requires the addition of one management forester, and travel expense, to aid the State Forester.
    c. Extend knowledge of forest conditions, to secure better public care; by addresses in schools and public gatherings, by press bulletins and publications, and by exhibits at fairs. The demands already created for this service cannot be met with present personnel; no part of the work is more important than to lay a solid ground-work of public appreciation and care of forests. Two staff foresters are needed for this work, and to aid in special economic investigation of the local condition sort, which carry conviction to the lay mind.

The effectiveness of the work of the present organization compares favorably with that of any state or Federal forest service. Funds now permit organized protection only in 26 counties. It is needed at once in 80, and ultimately in all counties.

The State Parks at Mount Mitchell and Fort Macon must show to the people who enjoy them an object lesson of reforestation. Their immediate and urgent needs are included in the following estimate of cost:

COST ESTIMATE FOR THE BIENNIUM BEGINNING JULY 1, 1925

FORESTRY DIVISION

			REQUESTED ESTIMATED NEEDS	
			1925	*1926*
Personal service			$110,800	$117,800
Supplies and materials			1,750	1,750
Postage, telephone, and express			2,400	2,400
Travel expense			12,300	12,300
Printing, binding, and publicity			3,500	3,500
Motor vehicles—upkeep			4,200	4,200
Light, power, and water			100	100
General expense			1,300	1,300
Equipment			3,050	3,050
Land, buildings, and permanent improvements			20,700	13,700
			$160,100	$160,100
Less coöperative funds expected:				
Federal	$60,000	$60,000		
Counties	12,000	20,000		
Other	250	250		
Total			72,250	80,250
State appropriation needed			$87,850	$79,850

STATE FORESTS AND PARKS

The only property of the State under the administration of this division of the Survey is the Mount Mitchell Park, consisting of 1,224 acres, including the summit of Mount Mitchell, whose altitude of 6,711 feet established it as the highest peak east of the Rocky Mountains. This area was fortunately bought in time to save a portion of the spruce and balsam forest, a far southern outpost of the typical Canadian forests, from the complete devastation of lumbering operations on these slopes.

The motor road constructed by the Mount Mitchell Development Company, together with Camp Alice at its upper end, about a mile below the summit of the mountain, has made this park accessible to many thousands of persons each summer. In 1923 the park warden registered the names and addresses of about 14,000 visitors to the summit between May 23 and November 19; probably at least as many more visited the summit without registering, and the same number drove as far up the mountain as Camp Alice without entering the park. In 1924 it was considered that the warden had too much responsibility in connection with guiding visitors and preventing mutilation of trees and shrubs to make it wise to occupy him with this registration, but the records of the toll-road to Camp Alice show that 4,992 automobiles made the trip, indicating the probability of more than 22,000 visitors to Camp Alice, 80 per cent of whom, or at least 17,600 persons, probably visited the park.

Agreement has been entered into between the Survey and the Mount Mitchell Development Company whereby the company is permitted to operate a small refreshment booth by the side of the trail just below the summit, under proper restrictions of sanitation and neatness, paying 10 per cent of gross receipts to the Survey for the privilege, and pays one-half the cost of maintaining the trail to the summit from Camp Alice. When not occupied with visitors, the park warden is engaged in keeping up trails and in planting over the bare areas. During March, 1923, balsam seed collected during the preceding fall in the park were sown on either side of the Camp Alice trail, and in April 500 Norway spruce trees, grown at the forest nursery of the Monongahela National Forest in Virginia, were planted in three different localities. Spruce seedlings, grown in a seed-bed in the park, and a number of balsam seedlings which had naturally grown, were transplanted. In 1924 an equal amount of transplanting was done. This process will require years, but will probably be the best method of restoring forest cover to the bare slopes.

Weather observation instruments are read by the park warden during his stay on the summit; the temperature appears to run about 15 degrees colder than Asheville.

An important improvement, undertaken by the National Forest Service, in which the Survey has coöperated, has been the construction of a bridle trail from Mount Mitchell peak northwardly through the park to Cattail, and thence along the edge of the National Forest to Deep Gap and Micaville. This will make the park accessible from these settlements in the event of need for fire-fighters. Agreement has been made with the National Forest Service for coöperation in bearing the cost, and contract entered into with the manufacturer, for the erection of a steel lookout tower carrying a watchman's cottage and observation platform thirty feet above the summit, to replace the sixteen-foot wooden tower. This will be occupied during the fire seasons in spring and fall by a watchman of the National Forest Service, equipped with proper instruments for observing and locating forest fires. Telephone connection will be provided over the present line to points in the Toe River Valley and to Marion, and later it is planned to connect direct with Asheville by way of Cane River Valley and Barnardsville.

There is great need of a new warden's cabin, roomy enough to provide shelter for campers and visitors from sudden storms; the present cabin has reached a state of decay which makes its repair inadvisable. The new cabin should not occupy the site of the present one, which spoils one of the most attractive natural features of the summit, the long-used "Campers' Cave."

Fort Macon State Park

At the meeting of the Geological Board in March, 1923, the Director was authorized to investigate the possibility of securing for the State the Fort Macon Military Reservation, opposite Beaufort and Morehead City, which had been recommonded by Congress for sale as surplus Federal property. Governor Morrison was interested, and one of our Senators took up with the War Department the possibility of its donation to the State. The Secretary of War found no authority to encourage such a prospect, and the Director of the Survey, with the advice of the Governor, undertook to secure private subscriptions from patriotic citizens to purchase the property, at its appraised valuation of $7,500, for gift to the State. Sufficient response not having been secured, the suggestion was made to some of our representatives in Congress that an effort be made through legislation to secure its gift to the State as a State Park. Congressman Charles Abernethy of New Bern took up and prosecuted the matter with energy, and with the help of Senator Simmons a joint measure was introduced into both houses providing for this transfer on February 16. The State Forester appeared with Mr. Abernethy before the House Committee on Military Affairs March 27, and later this committee reported the measure favorably. On May 20 Mr. Abernethy requested that his bill be put on as an amendment to House Bill 9124, "authorizing the sale of real property no longer required for military purposes"; this was done, and the bill enacted into law May 21. Mr. Abernethy originally based his request on the opinion that the site of this fort had originally been donated by the State to the Federal Government, and that it should be returned in like manner. It was later discovered by the Secretary of War that $1,200 had been paid for the property by the War Department, but this was not held to prevent its gift to the State. This turns over to the State approximately 410 acres of land on the extreme eastern end of Bogue Bank in Carteret County, containing the ruins of Fort Macon. The property is divided by a narrow strip, containing 22 acres, running from the sound to the ocean, and reserved to the Federal Treasury Department for a coast guard station, which has been established there for many years. There are approximately 100 acres to the east of this strip and 300 to the west of it.

From a very hurried and superficial inspection it seems that approximately one-half of the area of the reservation is beach and broken sand hills, the latter more or less held by the coarse grass, sea oats. Approximately one-fourth is thicket woodland and has a more or less poor cover of dwarfed trees and shrubs, which, judging from the shrubs and trees seen further down the island, probably contain a large proportion of red cedar, wax myrtle, live oak, laurel cherry, and groundsel tree. The remaining one-quarter of the reservation is marsh and open land surrounding the fort.

The Fort.—Fort Macon, used during the Civil War for military purposes, and after the close of that war as a military prison, is situated not far from the sound, but a good way from the beach and perhaps half a mile from the eastern point of the island. On approach it looks like a large, grass-covered mound surmounted by some large bushes, but on reaching the top of the mound the fort can be seen sunk in the sand hill. Until recently it was in a remarkably good state of preservation, the rooms opening up out of the interior courtyard being perfectly dry and in many places the lath and plaster still on the ceiling and walls. However, this is fast being removed, probably so that the larger pieces of lumber can be used for firewood. The moat can be crossed in two or more places on loose boards and blocks of wood. The interior of the fort is most picturesque. Several large red cedar trees have grown up since its abandonment, and in these are the nests of a colony of boat-tailed grackles, or so-called "jackdaws." Other woody plants noted in and around the fort were wax myrtle, hercules club (sometimes locally known as pillentary), white poplar, Spanish bayonet, groundsel tree (Baccharis), muscadine, poison ivy, and Virginia creeper.

Value of the Reservation to the State.—The historic and sentimental value of the fort should make it encumbent upon the State to secure its free use permanently for all the people. In addition to this, the reservation will form a most attractive recreation ground, the most accessible and the most centered of any similar area in the State. Only twenty minutes by boat from Beaufort, the eastern terminus of the Central Highway, and little more from Morehead City, it can readily be visited by people from all over the State. The beach, while not considered thoroughly safe for bathing, being too close to Beaufort Inlet, is used to some extent for this purpose. Certainly the western end of the reservation is far enough from the inlet to make bathing fairly safe, as there is a bathing pavilion only a short distance further up the beach. Fishing by hook and line in the surf would be another attraction. A number of different kinds of food fish are caught in this way.

Sand Hills.—Two or more studies relating to the possible fixation of sand dunes have been made by the State and Federal Governments, but no demonstration of the methods recommended or other methods have been attempted. This reservation would offer a fine opportunity for demonstrations of this kind, for if the property belonged to the State all money expended would thus be put into State property, and should certainly increase the value of that property.

The property was visited and carefully inspected on July 4th by the present Director, in company with Captain Goodwin of the Coast Guard Station referred to. It is my judgment that serious consideration must be given to restrictions as to where the public is to be admitted in the old fort. The cracks, which are understood to have been caused by the Charleston earthquake about forty years ago, appear to me to show signs of progressive weakening in some instances, and where timber shoring was built to support the arched walls, in one or two instances some of it is in a state of decay. The vandalism which the interior has suffered is outrageous, and if any portions of the old fort can be kept which will approximately indicate its original condition—which indeed it kept until comparatively a few years ago, when the War Department withdrew its caretaker—a thoroughly competent warden must be put in charge.

WATER RESOURCES

The division was established in the summer of 1920, and is the only organization connected with any Southern State department maintaining a personnel whose sole duty is the administration and investigation of matters relating to the State's water resources. As a result, North Carolina is generally recognized as leading all states in the South in these matters, and requests for data on the water resources of other Southern States are frequently received by this division from the states concerned. North Carolina maintains more stream gauging stations than all other South Atlantic States put together, and more than any other Southern State except Tennessee. It has been the only Southern State to inaugurate and carry out complete river investigations designed to show how streams may be developed as a unit; to collect and publish annual data relating to power installations and power output; to inaugurate investigations of evaporation, rainfall, and stream pollution; and to compile stream-flow data in the most complete and useful manner.

These accomplishments have been attained by a part-time personnel, and with a very small expenditure of State funds. While much has been done, a great deal has not been touched. The superiority of North Carolina recounted above has been in comparison with *Southern* States only. North Carolina is as greatly surpassed by many Northern and Western States.

If the industrial and civic growth of North Carolina is to continue, the use of her water resources for water-power and water-supply will be taxed to the utmost. It is essential that proper thought be given to their conservation, by planning for most judicious development and utilization with a maximum of efficiency. This study cannot be made other than by a State agency; local or private investigations are both too limited in scope and not available to the State's needs. Sound policy for successful democratic government demands that the conditions upon which full use and public benefit from these resources are dependent be investigated and made a matter of public knowledge and understanding.

First among these is a knowledge of the characteristics of stream flow—the amount of water which may be relied on to be furnished steadily, either for power production or for domestic or industrial use. This determination requires highly-trained technical skill, based on a series of observations through as long a period of time as possible. These consist in records of the fluctuations of the stage of the water in the stream from reading its height on a gauge daily, or oftener; and in actual instrumental measurements of the amount of water flowing in the stream at various gauge heights. Heretofore this work has necessarily been confined to the larger streams with large power possibilities. At various times prior to 1924 about 87 gauging stations have been operated, most of them for very short periods, however. Records of less than 10 years are not apt to be conclusive, unless readily correlated with existing long-term records on comparable watersheds. There are in North Carolina only 5 gauging stations with records over more than 25 years, and 10 more with records exceeding 10 years. These have been of great value; there is official acknowledgment that the development of the Aluminum Company of America at Baden would not have been built in North Carolina but for the excellent and long record of the flow of Yadkin River. The long record of the flow of the Cape Fear at Fayetteville enabled this division to furnish accurate records to the State Highway Department for bridge design, which enabled changes to be made in designs which saved $100,000 to the State. There is widespread need for these records on a number of smaller watersheds. Even among the limited number of municipal water supplies developed from surface streams in the State, there have been too many costly errors in estimate of supply. These have not been due so much to inexpert engineering as to the lack of fundamental data on the peculiarities of rainfall and the characteristics of stream flow, which only long-continued observations in many localities can supply. There are also a large number of moderate-sized and small streams having considerable power possibilities, which need gauging stations for the collection of the flow record on which their effective development must be based. Thirty-four gauging stations are now maintained; sixteen more are greatly needed to supply information for which there is immediate need.

The field work is done by the highly-expert men of the United States Geological Survey's Water Resources Division, coöperating with the North Carolina Survey; the field headquarters is at the Asheville office. Emergency field trips are occasionally made from the office of the hydraulic engineer at Chapel Hill. The personnel of this division is given at the beginning of this report.

The publication of the records gathered, in form to be of the greatest service, requires compilation and calculations requiring technical expertness of a high order. The records of the monthly maximum, minimum, and mean stream flow are published for each year of record in the Water Supply Papers of the United States Geological Survey. In addition, this division of the State Survey now has in preparation a bulletin collecting all stream-flow records made in the State prior to January 1,

1924. The data will be presented not only as monthly maximums, minimums, and means, but there will be given tables of weekly stream flow and duration curves of weekly stream flow for all important stations. It will be the most comprehensive collection of stream-flow data ever issued by any state east of the Mississippi; it is planned to keep its value up to date by annual compilations for each succeeding year's records, and a revision every 10 years.

Equally essential to the State's knowledge of the capacity of its water resources in aiding the future development of the State are water-power surveys. Two of these have been made by this division during the period of this report; one on the Hiwassee River and one on Deep River. The latter has been developed almost to readiness for publication, and has fulfilled its purpose so well as to deserve particular mention here. The power owners on Deep River were approached by the hydraulic engineer of the Survey, and became so interested in the possibilities of such a complete investigation of the capacity of Deep River to develop more power that nine of them jointly subscribed materially to the cost of the undertaking. The result of the survey and of possible joint-development plans which it disclosed, was to indicate the following with regard to this, one of the oldest power streams in the State, and generally considered to be highly developed.

The total fall from the crest of a proposed 40-foot dam near Jamestown to the north of Deep River at Moncure is 612 feet in 114 miles. The fall now developed is 302 feet. Of the 310 feet now undeveloped, the report indicates how 247 feet may be economically developed, utilizing 90 per cent of the total fall on the river.

At present, on Deep and Rocky rivers, 1,147 24-hour primary horsepower and 4,597 24-hour 7-months secondary horsepower is theoretically available. The stream-flow studies indicate very low unit discharge during the fall months; storage reservoir sites are pointed out whose development would increase the low-water flow about 300 per cent. If the rivers are fully developed in accordance with the scheme recommended, there can be produced 8,160 24-hour primary horsepower and 6,774 24-hour secondary horsepower. This is equivalent to 19,490 10-hour primary and 16,370 10-hour secondary horsepower.

Briefly, the report indicates that by a syndication of interests of the owners of riparian rights, seven times the amount of primary power now obtained may be developed. In addition, investigation of silting in existing power ponds shows that at many present plants more than half of the available power is lost through inability to store the night flow. The added possibilities of combining with this system mouth-of-mine steam auxiliary stations at the Deep River Coal Field are shown.

The object of this division of the Survey, like all the others, is to serve the common interest of all the people of the State by discovering and making known the important facts and conditions on which the public welfare hangs, with respect to our natural resources.

The public interest requires full use, under conditions which avoid needless waste or destruction. In water resources the first need is to determine by survey what they are and what their capacity to serve the public needs in a growing commonwealth. Immediately following this is the need of knowing the conditions of their ownership and use. Ownership which has a fixed policy of obstructing use could retard the proper growth and development of the surrounding region; or might play into the hands of selfish interests opposed to the general good of the community. This knowledge, gathered by the State, does not imply any effort of a department of the State to invade property rights; but, in view of the increasing authority exercised by the Federal Power Commission under the Federal Water Power Act of 1920, the State is under the necessity of informing itself of its sovereign rights and interest in its water resources, to be prepared against needless surrender of any of them.

For this reason this branch of the service, prosecuting surveys of the State's water-powers and what their complete development would consist in, is of great importance to the undeveloped sections of the State; and, also, though not so urgently, to certain portions of the industrial sections of the State, as disclosed by the survey of Deep River, referred to above.

Many of the surface waters of the State are of such a high degree of purity as to make them important in locating certain industrial plants, as bleacheries. A service of water-analyses for the uses of industry should be included in the program of this division.

Stream pollution will be an increasingly important concern of the State as population becomes more dense and industrial plants multiply. During the past biennium a beginning has been made in this study, in coöperation with the State Board of Health. It is considered that there are economic aspects of stream pollution, other than those affecting the public health, which makes it important for this division to coöperate in the studies.

Underground waters of the State need continued investigation. Knowledge of their capacity as a dependable source of supply has only partially been obtained; and there are many areas of the State to which such knowledge will become of increasing importance. The division desires to collect and make this information as complete as practical methods permit.

There are important duties of service to the executive and other branches of the State Government which this division should supply through its technical experts, and which, as far as its present means and personnel permit, it is now giving. Its work serves the Corporation Commission, the State Highway Department, and the division of the State Board of Health concerned with water supplies and sewage disposal. There is need to make this service thorough.

Coöperation with one or more of the schools of engineering in the State, in a service of investigation and practical assistance to landowners in the development of rural and farm power, is a project in which this division greatly desires to engage, and which its resources have not permitted in the past.

Interest on the part of the State in the development of its inland waterways as a means of reducing transportation costs and aiding our commerce should not be permitted to lag. A sound program of action must be based on expert surveys and investigations, which are largely outside of the field of service which can be obtained from the Federal War Department's Engineer Corps. In so far as this work is to be done by the State, more permanent and satisfactory results may be got by assigning it to this division, rather than through a series of investigations by special commissions.

Such a technical service as this involves the need of research in a number of fields; among such are silting in our streams and ponds, more complete studies of rainfall, studies of evaporation, of chlorine distribution in our ground waters, of hydrogenion concentration in ground and surface waters, of the removal of clay and silica from our waters. Such projects could often be worked out in coöperation with the two engineering schools if the Survey's working funds were sufficient to contribute to their cost.

This division of the Survey has actively coöperated in the work of the Southern Appalachian Water Power Conference, both in the programs of the meeting and in the preparation of a power-map of the Southeastern States, which has had wide circulation. The hydraulic enineer has also been active in the work of the North Carolina section of American Waterworks Association, composed of waterworks engineers and operators in the State, and which has made a distinguished record of progress.

The publications of this division, listed under the Division of Publications, have been in wide demand and been frequently reprinted or referred to by the technical press.

It has seemed desirable to go into this extended detail with regard to the work of this division for two reasons. It is desired to show how greatly the development of our State may be affected by the manner of our use of our water resources, and how their best use must be based on a knowledge of them which requires years of continued observation. It is also desired to show how much of the field is not yet touched, for lack of working funds. It may be stated confidently that no other state has a better record of accomplishment per dollar spent on this work than ours. This must largely be credited to the enthusiasm which has supplemented the ability of the men doing the work, and to the fact that the hydraulic engineer and several of the assistant engineers who are employed with the Survey on a part-time basis have contributed considerably more of their time and energy than is represented by their salary time.

The expenditures in this division are detailed in the following table:

WATER RESOURCES DIVISION

Disbursements for Biennial Period Ending June 30, 1924

Hydraulic engineer's salary	$3,192.76
Hydraulic engineer's expenses	966.68
Assistant engineer's salary	1,876.45
Assistant engineer's expenses	521.79
Field parties, including assistants' salaries	2,558.20
Stenographic services	626.98
Gauge reading	87.18
Coöperative—Asheville office—services and expenses	6,410.29
Special investigations	2,285.18
	$18,525.51

The estimated cost of the recommended program of work for the coming biennial period is as follows:

Cost Estimate for the Biennium Beginning July 1, 1925

WATER RESOURCES DIVISION

			Requested Estimated Needs	
			1925	*1926*
Personal service			$16,760	$24,160
Supplies and materials			1,100	1,150
Postage, telephone, and express			600	750
Travel expense			4,700	5,150
Printing, binding, and publicity			3,200	3,200
Motor vehicles—upkeep			1,500	2,250
General expense			990	990
Equipment			3,350	3,250
			$32,200	$40,900
Less coöperation expected:				
Federal	$4,000	$4,000		
Other	1,600	1,600		
Total expected			5,600	5,600
Needed from State appropriation			$26,600	$35,300

GEOLOGY AND MINING

This department has kept up the routine work of collecting and indexing statistics of the State's mineral production (this being done by the secretary to the Director, coöperating with the United States Geological Survey); and has made examination and report on 320 mineral specimens sent to it, and answered inquiries from many parts of the country for a wide variety of information on our minerals. The latter services were for the most part rendered by Dr. William F. Prouty, serving as Assistant Geologist. The Director's diary records many conferences and inquiries answered on North Carolina minerals.

In addition to the above routine service, special investigations and reports of unusual interest were made, as follows:

Mr. D. M. Moodie, a practical clay expert, was employed for an extended series of investigations and tests of clays and shales in many areas of the State. He attended the Eastern Carolina Exposition at Goldsboro and the State Fair at Raleigh in 1923, with exhibits and demonstrations, and aroused interest which promised to be of solid practical value to a number of clay owners and manufacturers.

Mr. Jasper L. Stuckey completed an exhaustive geological survey of the pyrophyllite (talc) deposits of the Glendon District in Moore County, and made a survey for moulding sands, 40 samples of which were subjected to standard tests through coöperation with the Foundryman's Association at the Bureau of Standards, Washington, D. C.

The field examination of the Deep River Coal Field in Lee and Chatham counties was completed by Messrs. Marius R. Campbell and Kent K. Kimball, of the United States Geological Survey; and the report published as Bulletin 33 of the Survey. This report gives the results of tests, which indicate the field of uses for which the coal is best adapted, and which prove its high quality. The quantity estimated as recoverable by present methods of mining is placed at 65,000,000 tons.

The preparation of a geological map of North Carolina, embodying revisions to date since the Kerr-Holmes map of 1890, was completed by Dr. William F. Prouty, of the Department of Geology of the University of North Carolina, serving as Assistant Geologist to the Survey. It is desired that this map be published as soon as printing appropriation permits.

Mention has been made of the employment of Dr. Jasper L. Stuckey, to report July 1, 1924, for full-time service as Geologist to the Survey. He is considered as being extraordinarily well equipped to serve the present needs for investigations of economic geology in the State; his studies in clays have been especially thorough. It is planned to have Dr. Stuckey proceed at once with a field study and report on the Mineral Industry of North Carolina, which has not been the subject of a thorough report since 1917. The six years to be covered by the report have been those of the greatest development of the State's mineral wealth.

Expenditures during the period of this report have been as follows:

GEOLOGICAL AND MINING DIVISION

Geologists' salaries	$2,220.44
Geologists' expenses	326.89
Chemical analyses	10.00
Total	$2,557.33

During the coming two-year period, if this division is to respond to present demands on it and render the service of which the Geologist is capable, the following are indispensable at once:

Indispensable additions to the library	$500
Necessary laboratory equipment (including microscope) and supplies	530

To fulfill the requirements of this division in an economic survey as hitherto outlined, provision must be made for the salaries and expenses of two summer field-survey parties, composed of geologists and student-assistants obtained from college departments. A total of $18,750 (not including State printing) is our estimate of total needs for the coming biennial period and reported to the Budget Commission.

An important service, often involving the need of the experienced judgment of this department, is in connection with the duties of the Insurance Department in "Blue Sky Law" enforcement. There have been many violations, consisting in fraudulent over-capitalization of mining operations as the basis for the sale of worthless stock.

BIOLOGY

This division was carried by the former Director, Colonel Pratt, as one of the organized subdivisions of the work of the Survey. As reported by him, Dr. W. C. Coker, head of the Department of Botany at the University of North Carolina, eminent in his field of work, was carried as biologist in charge. It was evidently anticipated that the Survey could furnish continued coöperation in the work under Dr. Coker's direction, and of particular interest in the economic survey of the State. A special study and report on "The Mushrooms of North Carolina," prepared by Dr. Coker and Miss Alma Holland, was thus aided to the extent of $350, and contemplated for publication by the Survey. Printing funds were not available, and no further appropriations were made to this division by the Survey during the past biennium, and only to the above extent should credit for Dr. Coker's valuable work properly be claimed by the Survey.

Invaluable assistance has been rendered the Survey in this Department by Dr. W. C. Coker, in consultation on inquiries in the field of botany, and by Dr. Robert E. Coker, equally eminent in the field of marine biology, and for many years in charge of a department in the United States Bureau of Fisheries, in connection with questions addressed to the Survey relating to marine biology. Grateful acknowledgment is made to these gentlemen.

MAPPING

The most important production of the Survey in this Division has been the publication of a new base map of North Carolina to the scale of 1:500,000, or approximately 8 miles to the inch, which was prepared through the coöperation of the United States Geological Survey and published by this Survey. This is believed to be the most accurate map of North Carolina yet published. It was received from the lithographers in March, 1924, and is listed and advertised with the Survey's publications available for distribution. Reference to its distribution is made under the head of the Division of Publications.

Reference is made in the Geological and Mining Division to the completion of the geological map of North Carolina to the same scale as the base map just described and embodying the results of valuable geological surveys to date. This has been delivered to the lithographers and the cost of its publication ascertained, but funds have not been available from present appropriations with which to publish it.

In the Water Resources Division principally new surveys and maps have been produced on water-power studies, notably on the Hiwassee River Power Survey, on Deep River Water-Power Survey, and the Water-Power Survey of Dan River, in Stokes County. The maps of Deep River Water-Power Survey have been published in connection with the report as Economic Paper No. 54. The other surveys and maps have not been published, but are held for publication with their respective reports. The work within this division has also included an important coöperative project carried out with the United States Coast and Geodetic Survey, consisting of the inspection of magnetic meridian markers in all of the county-seats of North Carolina, and the replacement of many such markers which had been displaced. Inasmuch as the North Carolina law requires land surveyors to make annual verification of their magnetic surveying compasses, these markers are essential to the observance of the State Law. A particular effort was made by the Survey to bring this service to the attention of all land surveyors in the State and to bring each of them into personal contact with Ensign McCormick, who performed the work, at the time the new observations and replacements were being made at the county-seat nearest to each such surveyor.

Repeated emphasis has been made in past reports on the great importance to North Carolina of securing the completion at the earliest possible date of the standard contour map produced by the United States

Survey as the official military map of the United States. The scale of this standard map is 1:62,500, or approximately one mile to the inch. The large amount of detail shown on this standard map, including differences of elevation of the surface topography, makes it invaluable in connection with many lines of investigation needed by industry and commerce. Its use in connection with the thorough economic survey of North Carolina, hitherto urged as one of the greatest needs of the State from the Geological and Economic Survey, would reduce enormously the cost of carrying out field investigations. This mapping is done by the Federal Survey on a coöperative basis, the State being expected to pay half the actual cost. This work has been completed for several states, but has been done for only a limited area of North Carolina. It should be considered indispensable in connection with an economical program of investigation of the State's resources and policies for their best development. To resume work on a basis which would insure the completion of this whole map of the State in ten years, it is estimated that an appropriation of $50,000 a year on the part of the State will be necessary. This is advised in our budget recommendation.

DRAINAGE AND RECLAMATION

During February, 1924, Maj. William D. Harris, as assistant to the Director, was assigned to the investigation of the present status of drainage projects hitherto undertaken in this State. The State Drainage Law prescribes certain requirements for the furnishing of records by the engineer in charge of a drainage district organized under the State Drainage Law for the records of this office, but these records have been very irregular and a study of them so inconclusive as to the present status of drainage projects in the State.

A compilation of the results of the above field investigation follows:

DRAINAGE DISTRICTS IN NORTH CAROLINA, JANUARY, 1924

County	Name of District	Acreage	Cost	Increase in Value per Acre	Principal Crops
Alexander	Wallace Creek (proposed)	275	$--------	-------------	
Alexander	South River (proposed)	550	---------	-------------	
Alexander	Elk Shoals (proposed)	550	---------	-------------	
Alexander	District No. 1	400	16,000	-------------	Completed Dec., 1923
Beaufort	Broad Creek	20,000	*50,000	$5 to $70	Corn, peas, potatoes
Beaufort	Pungo River	25,000	37,639	$35 to $100	Corn, peas, cotton
Beaufort	Pantego	30,000	35,000	-------------	
Beaufort	Albemarle	35,000	---------	-------------	
Beaufort	Jackson Swamp	4,000	---------	-------------	
Beaufort and Craven	Little Swift	18,000	135,000	To be completed Nov., 1925	
Bladen	District No. 1	3,123	30,000	-------------	Corn
Bladen (Pender)	White Oak Swamp†	1,500	---------	-------------	
Bladen (Pender)	Lyon Swamp	18,000	36,461	200 to 500%	Corn, cotton
Bladen (Pender)	White Oak Buckle Swamp	1,222	18,000	*$20 to $50	Corn
Cabarrus	Big Cold Water Creek	1,100	23,154	$75 to $100	Corn
Cabarrus	Irish Buffalo	1,375	35,600	*200 to 500%	Corn
Cabarrus	Coddle Creek	780	14,000	-------------	Corn
Cabarrus	Little Cold Water Creek	600	14,000	$25 to $75	Corn
Cabarrus	Dutch Buffalo	484	14,000	$25 to $75	Corn
Caldwell (Burke)	Laver Creek	3,000	15,000	$25 to $150	Corn
Camden (Currituck)	Camden Run	24,000	---------	-------------	
Carteret	District No. 2	4,575	82,000	$40 to $60	Corn, peas
Catawba	Clarks Creek	2,400	30,000	900%	Corn
Catawba	Lyles Creek	650	16,000	75%	Corn
Catawba	McLinns Creek, No. 1	260	6,500	*100%	Corn
Catawba	McLinns Creek, No. 2	250	6,500	*100%	Corn
Catawba	Pinch Gut Creek	350	---------	-------------	Corn and hay
Catawba	Robinson Creek	[1]1,100	6,500	-------------	Corn
Catawba	Horn Creek	230	6,500	Completed 1923	
Chowan (Perquimans)	Bear Swamp	5,000	25,000	50%	Corn, cotton
Cleveland	Buffalo Creek	15,000	67,000	50%	Pasture, corn
Columbus	Chadbourn	7,300	8,000	50%	Strawberries, cotton

DRAINAGE DISTRICTS IN NORTH CAROLINA, JANUARY, 1924—*Continued*

County	Name of District	Acreage	Cost	Increase in Value per Acre	Principal Crops
Columbus	Dist. No. 2 (near Bolton)	29,000	$200,000	------	
Craven (Pitt)	Clay Root Swamp†	6,000	75,000	------	
Craven (Lenoir)	Moseley Creek	8,500	50,000	50%	Corn
Craven	New Bern	Small area near city to be drained 1924 or 1925			
Cumberland	Flea Hill	20,425	78,492	300 to 400%	Corn, cotton, soybeans
Currituck	Moyock	14,000	50,000	50%	Corn, peas, soybeans
Duplin	No. 4 (proposed)	1,200	------	------	
Edgecombe (Halifax)	No. 1	6,300	------	------	
Forsyth	No. 1	2,100	53,000	[2]------	Corn
Forsyth	No. 2 (proposed)	1,700	------	------	
Gaston	Crowders Creek	1,200	15.000	*$50	Corn
Gaston	Big Long Creek	750	12,000	*$50	Corn
Gaston	Big Beaver Dam	250	7,000	*$50	
Gaston	Dutchmans Creek	1,000	15,000	300%	Corn, wheat, hay
Gaston	Lick Creek	230	4,500	Being completed now	
Harnett	Stewarts Creek	7,000	21,000	50%	Corn, cotton
Hyde	Mattamuskeet Lake Dist.	105,000	800,000	In receivership	
Hyde	District No. 5	7,000	------	In receivership	
Iredell	Little Rocky Creek	500	11,000	100%	Corn
Iredell	Fourth Creek	1,700	27,000	300%	Corn and hay
Iredell	Fifth Creek	302	7,500	200%	Corn and hay
Iredell	Fullo-Byers Creek	600	13,000	50%	Corn and hay
Iredell	Snow Creek	1,100	14,000	100%	Corn and hay
Iredell	Third Creek	1,825	25,600	300%	Corn and hay
Iredell	Withrows Creek	600	*10,000	------	
Iredell	Upper Coddle Creek	1,000	11,000	*100%	
Lincoln	Indian Creek	880	19,000	*100%	
Lincoln (Catawba)	Potts Creek	670	12,000	$74 to $200	Corn and hay
Mecklenburg	District No. 1	700	*10,000	$50	Corn
Mecklenburg	No. 2—Big Sugar Creek	200	*4,500	$50	Corn
Mecklenburg	No. 3—Briar Creek	250	7,000	$50	Corn
Mecklenburg	No. 4—McDowells Creek	730	12,000	$50	Corn
Mecklenburg	No. 5	1,185	*20,000	$50	Corn
Mecklenburg	No. 7—Jim Creek	1,100	16,000	$50	Corn and hay
Mecklenburg (Iredell)	Davidson Creek	1,675	23,000	$50	Corn and hay
Mecklenburg	No. 8—Ramah Creek	[3]1,500	11,000	Now being constructed	
New Hanover	District No. 1	2,500	16,200	*100 to 300%	[4]
New Hanover	District No. 2	500	12,500	100 to 300%	
New Hanover	District No. 3	2,000	18,000	------	
Pamlico	Palmetto District	12,000	50,000	[5]------	
Pasquotank	District No. 1[6]	7,146	38,000	Now being constructed	
Pender	Rocky Point	[7]7,000	7,717	*25 to 50%	
Pender	No. 4—Long Creek	14,000	175,000	[8]------	
Pender (Duplin and Sampson)	No. 5	32,000	158,895	[8]------	
Pender	Lyon Swamp	10,500	110,250	*25 to 50%	Corn
Perquimans	Parkville, No. 1	5,400	45,000	------	
Pitt	District No. 2	Merely talked of, as yet			
Robeson	Back Swamp and Jacob Swamp	35,000	142,000	50%	Corn, cotton, peas.
Rowan	Back Creek	890	14,500	$50 to $100	Corn and hay
Rowan	Grants Creek (upper end)	1,859	35,180	$50 to $100	Corn and hay
Rowan	Kerr Creek	595	10,500	$50 to $100	Corn and hay

DRAINAGE DISTRICTS IN NORTH CAROLINA, JANUARY, 1924—*Continued*

County	Name of District	Acreage	Cost	Increase in Value per Acre	Principal Crops
Rowan	Sills Creek	890	$ 15,000	$50 to $100	Corn and hay
Rowan	Beaver Dam	216	4,250	$50 to $100	Corn and hay
Rowan	Second Creek	590	13,000	$50 to $100	Corn and hay
Rowan (Iredell)	Third Creek	550	Drained b	y private par	ties
Rowan	Withrows Creek	1,118	20,000	$50 to $100	Corn and hay
Sampson	Big Coharie	3,500	Proposed		
Tyrrell	District No. 1	1,490	10,000	Contract let	Dec., 1923
Tyrrell	Columbia, Dist. No. 2	3,000	Being org	anized, Jan.,	1924
Tyrrell	Ridders Creek	877	4,920	*100%	Corn, cotton
Washington	District No. 4	10,000	45,000	300%	Corn, peas
Washington	District No. 5	12,500	119,000	100%	Corn, cotton, peanuts
Wayne	Dist. No. 2 (Nahunta Swamp)	[9]20,000	90,000	50%	Corn
Wayne	District No. 3	3,000	Being org	anized Dec.,	1923
Wayne (Greene and Lenoir)	Dist. No. 1 (Bear Creek)	3,000	23,400	200%	Corn
		‡500,367			

*Estimated. †Private enterprise.

‡Not including the district in Sampson County that is being talked of.

(This table includes about five-sixths of the drained area in the State.)

[1] 350 bottom.

[2] For health reasons—sewer.

[3] 1,000 upland.

[4] Mostly used for residential development.

[5] Private enterprise for land development.

[6] Nos. 2. 3, and 4, being proposed, along State highway.

[7] Including all drained.

[8] District now tied up in litigation.

[9] 6,000 or 7,000 taxable.

DRAINAGE DISTRICTS BEGUN IN NORTH CAROLINA DURING 1924

County	Name of District	Acreage	Cost	Name of Engineer
Beaufort	Near Aurora		$	Engineer and other details unknown
Cabarrus	No. 6	1,400	*30,000	Will D. Alexander
Cumberland	Flea Hill		80,000	None
Lincoln	No. 3	300	10,000	None
Mecklenburg	No. 6 (Mallard Creek)	1,200	10,500	
Mecklenburg	No. 9 (Long Creek)			Will D. Alexander
Pitt	No. 2	15,000		Mr. Rivers
Tyrrell	No. 1 (Sound Side Drainage District)	1,000		Will D. Alexander

*Estimated.

PROPOSED DISTRICTS

Beaufort—South Creek Drainage District; Albemarle Drainage District.
Cumberland—No name; Mr. Wetmore, of Lumberton, engineer.
Duplin—Four projects started but none completed.
Davie—No name; petitions not signed yet.
Davidson—No name; petitions not signed yet.
Guilford—Small project, unnamed; Frank T. Miller, Consulting Engineer.
Robeson—No name; Mr. Wetmore, of Lumberton, Engineer.
Sampson—Two districts being considered: nothing done.

With the idea of extending the provisions of the Federal Reclamation Act to include the reclamation of southern swamp lands instead of only the irrigation of arid western lands, as at present, led to the calling of a conference on Drainage Reclamation and Home-making, in New Orleans, on November 19-22, 1923. Growing out of this conference it is expected that investigations will be made in southern states as to the practical prospects of profitably extending the operation of the act. The Director of this Survey was largely instrumental in effecting the above conference.

Where no problem of land settlement has been involved, land drainage has proved highly profitable in the State. The Piedmont projects have been uniformly successful. Only where eastern swamp reclamation projects have been of a size greatly exceeding the need of land for early use have the results been discouraging.

Land reclamation on a large scale and producing agricultural soils of high fertility are possible in Eastern North Carolina, but sound policy dictates that these projects should await thoroughly successful experience in immigration and land settlement. The several amendments passed by the General Assembly of 1923, relating to the North Carolina Drainage Law, caused the Survey to publish, as Circular No. 8 of the Geological and Economic Survey, an annotated and complete compilation of the North Carolina Drainage Law.

No separate expenditures have been accounted under this division; both in expenditures and in estimated needs for the coming biennium it is included with the Division of Administration.

PUBLICITY AND PUBLICATIONS

During the period covered by this report, December 1, 1922, to July 1, 1924, the following publications have been issued by the Survey:

Circulars

No. 5. "Amendments to the North Carolina Drainage Law, passed by the General Assemblies of 1919, 1921, and 1923." April, 1923.
No. 6. "The Water Power Situation in North Carolina." June, 1923.
No. 7. "Forest Fires and the Boll Weevil."
No. 8. "North Carolina Drainage Law, Annotated."
No. 9. "Federal Forest Purchases and Forest Recreation."

Press Notices 238 to 269, dealing with subjects of particular and immediate interest which arise in the course of the Survey's work, and considered worthy of publication through the daily papers of the State.

Bulletins

No. 30. "The Wood-using Industries of North Carolina." Delivered to the printer December 29, 1921; report received April, 1924.
No. 32. "The Magnetic Iron Ores of Western North Carolina and Eastern Tennessee," a joint publication through the coöperation of United States Survey, Geological Survey of Tennessee, and North Carolina Geological and Economic Survey; received from printer, 1924.
No. 33. "The Deep River Coal Field of North Carolina." Sent to printer June 5, 1923; received for distribution, 1924.

Volumes

Vol. V. "Cretaceous Formations of North Carolina."
Part I. Invertebrates of the Upper Cretaceous Formations, by Lloyd William Stephenson.

The following have been prepared (as of July 1, 1924), but not yet published for lack of printing appropriation:

*No. 29. "Kaolins of Western North Carolina," by W. S. Bayley.
*No. 31. "Brown Iron Ores of North Carolina," by W. S. Bayley.
*No. 34. "Titanium Ores of North Carolina," by W. S. Bayley.

Economic Papers

No. 54. "Water Power Investigation of Deep River." In press June 30, 1924.

Volumes

Vol. V. "Cretaceous Formations of North Carolina."
Part II. Cretaceous Reptilia of North Carolina, by C. W. Gilmore.
Part III. Cretaceous Flora, by Edward W. Berry.
(Both parts written through coöperation of U. S. Geological Survey, have not been forwarded to the printer for lack of printing funds.)

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*Coöperative publications in connection with United States Geological Survey.

Probably the most useful addition to the publications of the Survey during the past biennium has been its bi-weekly publication, "Natural Resources," under the editorship of Mr. R. L. Gray. This is written in nontechnical style, and is devoted to the effort to give a more popular conception of the practical side of conservation and development of the State's natural resources. Its circulation has been carefully studied, and through it a large number of avenues of usefulness for the Survey and an equal or greater number of interested and active allies in the work of promoting sound public policies have been developed. The present mailing list of "Natural Resources" includes 150 bankers, 125 chambers of commerce and other commercial organizations, 100 sash, door and millmork manufacturers, 100 forestry exchanges, 65 public libraries, 400 civic clubs and officers, 300 newspapers and other exchanges, 100 hotels, 100 county commissioners, 30 colleges and schools, and 1,500 forest wardens. Articles in "Natural Resources" have received generous quotation from the press, both within the State and beyond. Among the latter may be noted the *New York Times,* which has repeatedly published "Natural Resources" articles, and the *Literary Digest,* of New York. The most distant reprint of a "Natural Resources" article thus far noted was in New Zealand.

Repeated effort has been made to secure second-class mailing privilege for this publication, thus far without success, the Survey not falling technically under the provisions for that rate.

Upon moving the offices of the Survey from Chapel Hill to Raleigh, the Director requested and obtained the permission of the board to make free distribution of the large accumulation of past publications of the Survey, stored in Chapel Hill, in library packages, to the various schools, colleges, and public libraries of the State. This distribution included also a copy to each of the new base map of North Carolina heretofore referred to. Abundant response has been received, indicating the value of this distribution.

The service of publications and publicity has included exhibits at the principal expositions of the State. These have been carefully prepared and attended by one or more members of the Survey staff, and have been the means of greatly widening the field of usefulness.

During the period of this report such exhibits have been placed at the State Fair in Raleigh, at the Eastern Carolina Exposition at Wilson in 1923, and at Kinston in 1924. Many thousands of persons were reached and interested through these exhibits. This feature has been further extended by the preparation of special forest-fire protection exhibits for use by the district foresters at the county fairs, and a valuable amount of educational work has been done by means of these.

In addition to printed publications and exhibits, this division of the work has included the preparation and arrangement for the delivery of numerous addresses by the Director and the various members of the Survey staff.

The expenditures under this division and the estimated cost of its operation during the coming biennium are included under the Division of Administration.

FINANCIAL STATEMENT

RECEIPTS AND DISBURSEMENTS OF THE NORTH CAROLINA GEOLOGICAL AND ECONOMIC SURVEY FOR THE FISCAL BIENNIUM FROM DECEMBER 1, 1922, TO JUNE 30, 1924.

Receipts

Balance on hand December 1, 1922		$903.15
Received from State Treasurer		77,416.70
From Forestry Coöperation:		
Federal	$24,138.64	
County	7,900.18	
Local	100.55	
		32,139.37
Water Resources:		
Stream gauging	$472.15	
Hiwassee River	1,694.95	
Deep River	75.00	
County	125.00	
Refund	45.00	
		2,412.10
Interest on daily bank balances		200.47
Sale of Publications		670.04
Sale of equipment—Mount Mitchell		336.57
Rent of privileges—Mount Mitchell		21.25
Clerical work from:		
Southern Appalachian Water Power Conference	$160.17	
N. C. Drainage Association	136.00	
Southern Forestry Congress	28.70	
Southern Railway Company	15.00	
		341.87
Refunds from overpaid accounts		40.90
Miscellaneous		10.00
Total		$114,492.42

Disbursements

Administrative and Records Division (including equipment for all divisions)	$41,929.37
Forestry Division (including State Parks)	46,655.94
Water Resources Division	18,525.51
Geological and Mining Division	2,557.33
Mapping Division	508.77
Biological	350.00
Balance on hand, July 1, 1924	3,965.50
	$114,492.42

This statement is checked by official audit reported to the State Auditor by R. C. Birmingham and Company, Certified Public Accountants, under date of September 16, 1924.

LIST OF PUBLICATIONS

Natural Resources, a bi-weekly publication, devoted to information about and discussion relating to the conservation and development of the State's natural resources and their place in the life of the people, is written in popular style and is mailed free upon application. Its contents are available, for use in the press or otherwise, with or without credit or acknowledgment.

There have been printed and, with the exception of a few out of print, are on hand for distribution at the prices noted a number of publications—Bulletins, Economic Papers, Volumes, Reports, Circulars—covering a wide variety of subjects and special studies, as follows:

MINES AND MINERALS

Bulletin 1. Iron Ores of North Carolina, by Henry B. C. Nitze, 1893. 8°, 239 pp., 20 pl., and map. *Out of print.*

Bulletin 2. Building and Ornamental Stones in North Carolina, by T. L. Watson and F. B. Laney in collaboration with George P. Merrill, 1906. 8°, 283 pp., 32 pl., 2 figs. *25 cents. Cloth-bound copy 50 cents extra.*

Bulletin 3. Gold Deposits in North Carolina, by Henry B. C. Nitze and George B. Hanna, 1896. 8°, 196 pp., 14 pl., and map. *Out of print.*

Bulletin 9. Monazite and Monazite Deposits in North Carolina, by Henry B. C. Nitze, 1895. 8°, 47 pp., 5 pl. *Out of print.*

Bulletin 10. Gold Mining in North Carolina and Other Appalachian States, by Henry B. C. Nitze and A. J. Wilkens, 1897. 8°, 164 pp., 10 pl. *10 cents.*

Bulletin 11. Corundum and the Basic Magnesian Rocks of Western North Carolina, by J. Volney Lewis, 1895. 8°, 107 pp., 6 pl. *5 cents.*

Bulletin 12. History of the Gems Found in North Carolina, by George Frederick Kunz, 1907. 8°, 60 pp., 15 pl. *5 cents.*

Bulletin 13. Clay Deposits and Clay Industries in North Carolina, by Heinrich Ries, 1897. 8°, 157 pp., 12 pl. *10 cents.*

Bulletin 19. The Tin Deposits of the Carolinas, by Joseph Hyde Pratt and Douglas B. Sterrett, 1905. 8°, 64 pp., 8 figs. *4 cents.*

Bulletin 21. The Gold Hill Mining District of North Carolina, by Francis Baker Laney, 1910. 8°, 137 pp., 23 pl., 5 figs. *15 cents. Cloth copies, 75 cents.*

Bulletin 22. A Report on the Cid Mining District, Davidson County, N. C., by J. E. Pogue, Jr., 1911. 8°, 144 pp., 22 pl., 5 figs. *15 cents. Cloth copies, 75 cents.*

Bulletin 25. Zircon, Monazite, and Other Minerals Used in the Production of Chemical Compounds Employed in the Manufacture of Lighting Apparatus, by Joseph Hyde Pratt, Ph.D., 1916. 8°, 120 pp., 3 pl. *15 cents. Cloth copies, 75 cents.*

Bulletin 26. A Report on the Virgilina Copper District of North Carolina and Virginia, by F. B. Laney, Ph.D., 1917. 8°, 176 pp., 20 pl., 16 figs. *Out of print.*

Bulletin 28. Limestones and Marls of North Carolina, by G. F. Loughlin, E. W. Berry, and J. A. Cushman. Prepared by the North Carolina Geological and Economic Survey in coöperation with the United States Geological Survey, 1921. 8°, 211 pp., 7 pl., 3 figs. *15 cents.*

Gives a complete description of the various deposits of limestones and marls in North Carolina by sections and by counties; the history of their production and use; describes plants now operating in the State, and discusses the possible future of the limestone and marl industry of North Carolina.

Bulletin 29. The Kaolins of North Carolina, by W. S. Bayley. Prepared in coöperation with the U. S. Geological Survey. *In press.*

Bulletin 31. Deposits of Brown Iron Ores (Brown Hematite) in Western North Carolina, by W. S. Bayley. *In press.*

Bulletin 32. Magnetic Iron Ores of Western North Carolina and Eastern Tennessee, by W. S. Bayley. *15 cents.*

Bulletin 33. The Deep River Coal Field of North Carolina, by Marius R. Campbell and Kent K. Kimball. Prepared in coöperation with U. S. Geological Survey. *10 cents.*

Economic Paper 3. Talc and Pyrophyllite Deposits in North Carolina, by Joseph Hyde Pratt, 1900. 8°, 29 pp., 2 maps. *2 cents.*

Economic Paper 4. The Mining Industry in North Carolina During 1900, by Joseph Hyde Pratt, 1901. 8°, 36 pp. and map. *Out of print.*

Takes up in some detail Occurrences of Gold, Silver, Lead and Zinc, Copper, Iron, Manganese, Corundum, Granite, Mica, Talc, Pyrophyllite, Graphite, Kaolin, Gem Minerals, Monazite, Tungsten, Building Stones, and Coal in North Carolina.

Economic Paper 6. The Mining Industry in North Carolina During 1901, by Joseph Hyde Pratt, 1902. 8°, 102 pp. *Out of print.*

Gives a list of Minerals found in North Carolina; describes the Treatment of Sulphuret Gold Ores, giving localities; takes up the Occurrence of Copper in the Virgilina, Gold Hill, and Ore Knob districts; gives Occurrences and Uses of Corundum; a List of Garnets, describing Localities; the Occurrence, Associated Minerals, Uses and Localities of Mica; the Occurrence of North Carolina Feldspar, with Analyses; an extended description of North Carolina Gems and Gem Minerals; Occurrences of Monazite, Barytes, Ocher; describes and gives Occurrences of Graphite and Coal; describes and gives Occurrences of Building Stones, including Limestones; describes and gives Uses for the various forms of Clay; and under the head of "Other Economic Minerals" describes and gives Occurrences of Chromite, Asbestos, and Zircon.

Economic Paper 7. The Mining Industry in North Carolina During 1902, by Joseph Hyde Pratt, 1903. 8°, 27 pp. *5 cents.*

Economic Paper 8. The Mining Industry in North Carolina During 1903, by Joseph Hyde Pratt, 1904. 8°, 74 pp. *5 cents.*

Gives description of Mines worked for Gold in 1903; description of Properties worked for Copper during 1903, together with assay of ore from Twin-Edwards Mine; Analyses of Limonite ore from Wilson Mines; the Occurrence of Tin; in some detail the Occurrences of Abrasive; Occurrences of Monazite and Zircon; Occurrences and Varieties of Graphite, giving Methods of Cleaning; Occurrences of Marble and other forms of Limestone; Analysis of Kaolin from Barber Creek, Jackson County, North Carolina.

Economic Paper 9. The Mining Industry in North Carolina During 1904, by Joseph Hyde Pratt, 1905. 8°, 95 pp. *4 cents.*

Gives Mines Producing Gold and Silver during 1903 and 1904, and Sources of the Gold Produced during 1904; describes the mineral Chromite, giving Analyses of Selected Samples of Chromite from Mines in Yancey County; describes Commercial Varieties of Mica, giving the manner in which it occurs in North Carolina, Percentage of Mica in the Dikes, Methods of Mining, Associated Minerals, Localities: Uses; describes the mineral Barytes, giving method of Cleaning and Preparing Barytes for Market; describes the use of Monazite as used in connection with the Preparation of the Bunsen Burner, and goes into the use of Zircon in connection with the Nernst Lamp, giving a list of the Principal Yttrium Minerals; describes the minerals containing Corundum Gems, Hiddenite and Other Gem Minerals, and gives New Occurrences of these Gems; describes the mineral Graphite and gives new Uses for same.

Economic Paper 11. The Mining Industry in North Carolina During 1905, by Joseph Hyde Pratt, 1906. 8°, 95 pp. *5 cents.*

Describes the mineral Cobalt and the principal minerals that contain Cobalt; Corundum Localities; Monazite and Zircon in considerable detail, giving Analyses of Thorianite; describes Tantalum Minerals and gives description of the Tantalum Lamp; gives brief description of Peat Deposits; the manufacture of Sandlime Brick; operations of Concentrating Plant in Black Sand Investigations; gives Laws Relating to Mines, Coal Mines, Mining, Mineral Interests in Land, Phosphate Rock, Marl Beds.

Economic Paper 14. The Mining Industry in North Carolina During 1906, by Joseph Hyde Pratt, 1907. 8°, 144 pp., 20 pl., and 5 figs. *10 cents.*

Under the head of "Recent Changes in Gold Mining in North Carolina," gives methods of mining, describing Log Washers, Square Sets, Cyanide Plants, etc., and detailed descriptions of Gold Deposits and Mines are given; Copper Deposits of Swain County are described; Mica Deposits of Western North Carolina are described, giving Distribution and General Character, General Geology, Occurrence, Associated Minerals, Mining and Treatment of Mica, Origin, together with a description of many of the mines; Monazite is taken up in considerable detail as to Location and Occurrence, Geology, including classes of Rocks, Age, Associations, Weathering, method of Mining and Cleaning, description of Monazite in Original Matrix.

Economic Paper 15. The Mining Industry in North Carolina During 1907, by Joseph Hyde Pratt, 1908. 8°, 176 pp., 13 pl., and 4 figs. *15 cents.*

Takes up in detail Copper and the Gold Hill Copper District; a description of the Uses of Monazite and its Associated Minerals; description of Ruby, Emerald, Beryl, Hiddenite, and Amethyst Locations; a detailed description with Analyses of the Principal Mineral Springs of North Carolina; a description of the Peat Formations in North Carolina, together with a detailed account of the uses of Peat and the Results of an Experiment Conducted by the United States Geological Survey on Peat from Elizabeth City, North Carolina.

Economic Paper 23. The Mining Industry in North Carolina During 1908, '09, and '10, by Joseph Hyde Pratt and Miss H. M. Berry, 1911. 8°, 134 pp., 1 pl., 27 figs. *10 cents. Cloth copies 50 cents extra.*

Gives report of Virgilina Copper District of North Carolina and Virginia, by F. B. Laney; Detailed report on Mica Deposits of North Carolina, by Douglas B. Sterrett; Detailed report on Monazite, by Douglas B. Sterrett; Reports on various Gem Minerals, by Douglas B. Sterrett; Information and Analyses concerning certain Mineral Springs; Extract from Chance Report of the Dan River and Deep River Coal Fields; some notes on the Peat Industry, by Professor Charles A. Davis; Extract from report of Arthur Keith on the Nantahala Marble; Description of the manufacture of Sand-lime Brick.

Economic Paper 34. The Mining Industry in North Carolina During 1911-1912, by Joseph Hyde Pratt, State Geologist, 1914. 8°, 63 pp., 23 pl., 12 figs. *15 cents.*

Gives detailed report on Gold Mining in various counties, with special report on Metallurgical processes used at the Iola Mine, by Claud Hafer; description of a Cyanide Mill by Percy Barbour; the new milling process for treating North Carolina Siliceous Gold Ores at the Montgomery Mine, including a description of the Uwharrie Mining Company's Plant; notes on the Carter Mine, Montgomery County, by Claud Hafer; also a description of the Howie Mine and its mill; a detailed report of the Coggins (Appalachian) Gold Mine, by Joseph Hyde Pratt; a list of gems and gem minerals occurring in the United States; special descriptions of Localities where the Amethyst, Beryl, Emerald, and Quartz Gems Occur, as taken from United States Geological Survey Report by Douglas B. Sterrett; a report on the Dan River Coal Field, by R. W. Stone, as reprinted from Bulletin 471-B of the United States Geological Survey; a special report on Graphite, by Edson S. Bastin, and reprinted from Mineral Resources of United States for 1912; a special report on Asbestos, describing both the Amphibole and Chrysotile varieties; a report on the Mount Airy Granite Quarry; special report on Sand and Gravel, giving Uses, Definitions of Various Sands, etc., the portion of a Bulletin on Feldspar and Kaolin, of the United States Bureau of Mines, which relates to North Carolina, and which takes up in detail Occurrences, Methods of Mining, and Descriptions of Localities of Feldspar and Kaolin mines in North Carolina, prepared by Mr. A. S. Watts. In this Economic Paper are also given the names and addresses of producers of the various minerals during the years covered by the report.

Economic Paper 49. The Mining Industry in North Carolina During 1913-1917, inclusive, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1919. 8°, 170 pp. *20 cents.*

Gives list of useful minerals of North Carolina; contains detailed report on the Uwharrie Mill at Candor; data relating to the brown hematite iron ores and a special report on the titaniferous iron ores of the State; report on tin resources of the Kings Mountain District; special data relating to manganese; green-sand; marble deposits of Cherokee County; clay tests.

Economic Paper 55. The Mineral Industry in North Carolina, 1918-1923, inclusive, by Brent S. Drane, Director, and Jasper L. Stuckey, Geologist, 1925. 8°, 104 pp. *25 cents.*

Gives list of useful minerals of North Carolina; contains general account of all minerals and mineral products mined or quarried in the State; data on iron, coal, feldspar, mica, stone, sand and gravel, talc and pyrophyllite, and clay and shale; gives special attention to feldspar, with list of most important mines; special data on high-grade clay and kaolin, shales and shale products; clay tests.

EXAMINATION OF MINERAL SPECIMENS

Samples of any mineral found in the State may be sent to the office of the Geological and Economic Survey, Raleigh, N. C., for identification, and the same will be classified free of charge. It must be understood, however, that NO ASSAYS OR QUANTITATIVE DETERMINATIONS WILL BE MADE. Samples should be in lump form, if possible, and marked plainly on outside of package with name of sender, postoffice address, etc.; a *letter* should accompany sample and *stamp* should be enclosed for reply.

FORESTS, FIRE PREVENTION

Bulletin 5. The Forests, Forest Lands, and Forest Products of Eastern North Carolina, by W. W. Ashe, 1894. 8°, 128 pp., 5 pl. *5 cents.*

Bulletin 6. The Timber Trees of North Carolina, by Gifford Pinchot and W. W. Ashe, 1897. 8°, 227 pp., 22 pl. *Out of print.*

Bulletin 7. Forest Fires: Their Destructive Work, Causes and Prevention, by W. W. Ashe, 1895. 8°, 66 pp., 1 pl. *5 cents.*

Bulletin 16. Shade Trees for North Carolina, by W. W. Ashe, 1908. 8°, 74 pp., 10 pl., 16 figs. *5 cents.*

Bulletin 17. Terracing of Farm Lands, by W. W. Ashe, 1908. 8°, 38 pp., 6 pl., 2 figs. *4 cents.*

Bulletin 23. Forest Conditions in Western North Carolina, by J. S. Holmes, 1911. 8°, 116 pp., 8 pl. *15 cents.*

Bulletin 24. Loblolly or North Carolina Pine, by W. W. Ashe, Forest Inspector, U. S. Forest Service (and former Forester of the North Carolina Geological and Economic Survey). Prepared in coöperation with the Forest Service, U. S. Department of Agriculture, 1914. 8°, 176 pp., 27 pl., 5 figs. *15 cents. Cloth copies 75 cents.*

Bulletin 30. Wood-using Industries of North Carolina, by R. K. Helphenstine, Jr., 1923. Prepared in coöperation with the U. S. Forest Service. *15 cents.*

Economic Paper 1. The Maple Sugar Industry in Western North Carolina, by W. W. Ashe, 1897. 8°, 34 pp. *2 cents.*

Economic Paper 19. Forest Fires in North Carolina During 1909, by J. S. Holmes, Forester, 1910. 8°, 52 pp., 9 pl. *5 cents.*

Economic Paper 20. Wood-using Industries of North Carolina, by Roger E. Simmons, under the direction of J. S. Holmes and H. S. Sackett, 1910. 8°, 74 pp., 6 pl. *10 cents.*

Economic Paper 22. Forest Fires in North Carolina During 1910, by J. S. Holmes, Forester, 1911. 8°, 48 pp. *Out of print.*

Economic Paper 25. Proceedings of Second Annual Convention of the North Carolina Forestry Association, held at Raleigh, North Carolina, February 21,

1912. Forest Fires in North Carolina During 1911. Suggested Forestry Legislation. Compiled by J. S. Holmes, Forester, 1912. 8°, 71 pp. *5 cents.*

Economic Paper 33. Forest Fires in North Carolina During 1912 and National and Association Coöperative Fire Control, by J. S. Holmes, Forester, 1913. 8°, 63 pp. *5 cents.*

Economic Paper 37. Forest Fires in North Carolina During 1913 and a Summary of State Forest Fire Prevention in the United States, by J. S. Holmes, Forester, 1914. 8°, 82 pp. *8 cents.*

Economic Paper 40. Forest Fires in North Carolina During 1914 and Forestry Laws of North Carolina, by J. S. Holmes, State Forester, 1915. 8°, 55 pp. *5 cents.*

Economic Paper 42. Organization of Coöperative Forest Fire Protective Areas in North Carolina, being the Proceedings of the Special Conference on Forest Fire Protection, held as part of the Conference on Forestry and Nature Study, Montreat, N. C., July 8, 1915. Prepared by J. S. Holmes, State Forester, 1915. 8°, 39 pp. *4 cents.*

Economic Paper 46. The Vegetation of Shackleford Bank, by I. F. Lewis, 1917. 8°, 40 pp., 11 pl. *10 cents.*

Economic Paper 48. Forest Fires in North Carolina During 1915, 1916, and 1917, and Present Status of Forest Fire Prevention in North Carolina, by J. S. Holmes, State Forester, 1918. 8°, 97 pp. *10 cents.*

Economic Paper 51. Forest Fires in North Carolina During 1918, 1919, and 1920, and Forest Protection in North Carolina, by J. S. Holmes, State Forester, 1921. 8°, 82 pp. *10 cents.*

Circular No. 1. The Forest Problem in North Carolina, by W. Darrow Clark, May, 1922.

Circular No. 7. Forest Fires and the Boll Weevil, by Fred B. Merrill, 1923.

Circular No. 3. Forestry Problem of the Southern Appalachian and Southeastern States, by Joseph Hyde Pratt, 1922.

Circular No. 9. Federal Forest Purchases and Forest Recreation, by Verne Rhodes, 1924.

Circular No. 11. Forest Fires and Taxation, by K. E. Kimball, 1925.

WATER-POWER RESOURCES

Bulletin 8. Water Powers in North Carolina, by George F. Swain, Joseph A. Holmes, and E. W. Myers, 1899. 8°, 362 pp., 16 pl. *16 cents.*

Bulletin 20. Water Powers of North Carolina: An Appendix to Bulletin 8, 1910. 8°, 383 pp. *25 cents.*

Economic Paper 53. Water Power Survey of Surry and Wilkes Counties, by Thorndike Saville, 1922. 8°, 41 pp. *10 cents.*

Circular No. 2. The Water-Power Situation in North Carolina, by Thorndike Saville, 1922. *Out of print.*

Circular No. 6. The Water-Power Situation in North Carolina, by Thorndike Saville, 1923. (This circular contains the same information as Circular No. 2, brought up to date.)

Circular No. 10. The Water-Power Situation in North Carolina, by Thorndike Saville, 1924.

DRAINAGE

Economic Paper 17. Proceedings of Drainage Convention, held at New Bern, North Carolina, September 9, 1908. Compiled by Joseph Hyde Pratt, 1908. 8°, 94 pp. *5 cents.*

Economic Paper 18. Proceedings of Second Annual Drainage Convention, held at New Bern, North Carolina, November 11 and 12, 1909, compiled by Joseph Hyde Pratt, and containing North Carolina Drainage Law, 1909. 8°, 50 pp. *5 cents.*

Economic Paper 21. Proceedings of the Third Annual Drainage Convention, held under auspices of the North Carolina Drainage Association and of the North Carolina Drainage Law (codified). Compiled by Joseph Hyde Pratt, 1911. 8°, 67 pp., 3 pl. *Out of print.*

Economic Paper 26. Proceedings of the Fourth Annual Drainage Convention, held at Elizabeth City, North Carolina, November 15 and 16, 1911, compiled by Joseph Hyde Pratt, State Geologist, 1912. 8°, 45 pp. *Out of print.*

Economic Paper 31. Proceedings of the Fifth Annual Drainage Convention, held at Raleigh, N. C., November 26 and 27, 1912. Compiled by Joseph Hyde Pratt, State Geologist. 8°, 56 pp., 6 pl. *5 cents.*

Economic Paper 38. Forms Covering the Organization of Drainage Districts Under the North Carolina Drainage Law, chapter 442, Public Laws of 1909, and Amendments. And Forms for Minutes of Boards of Drainage Commissioners Covering the Organization of the Board up to and Including the Issuing of the Drainage Bonds. Compiled by George R. Boyd, Drainage Engineer. 133 pp. *25 cents.*

Economic Paper 41. Proceedings of the Seventh Annual Drainage Convention of the North Carolina Drainage Association, held at Wilson, North Carolina, November 18 and 19, 1914. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1915. 8°, 76 pp., 3 figs. *5 cents.*

Economic Paper 45. Proceedings of the Eighth Annual Drainage Convention. Held under the auspices of the North Carolina Drainage Association and the North Carolina Geological and Economic Survey, Belhaven, N. C., November 29, 30, and December 1, 1915. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary. 8°, 90 pp. *15 cents.*

Economic Paper 47. Proceedings of the Ninth Annual Drainage Convention of the North Carolina Drainage Association, held at Greensboro, N. C., November 22 and 23, 1916. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1917. 8°, 110 pp., 8 figs. *15 cents.*

Economic Paper 50. Proceedings of the Tenth Annual Drainage Convention, held at Washington, N. C., March 31 and April 1, 1920. Compiled by North Carolina Geological and Economic Survey, 1920. 8°, 78 pp. *10 cents.*

Economic Paper 52. Proceedings of the Eleventh Annual Drainage Convention, held at Elizabeth City, N. C., April 12 and 13, 1921. Compiled by the North Carolina Geological and Economic Survey, 1921. 8°, 69 pp. *10 cents.*

Circular No. 4. Drainage Assessments: Their Imposition and Their Collection Under the North Carolina Drainage Law, by Frank Nash, Assistant Attorney-General, August, 1922.

Circular No. 5. Amendments to the North Carolina Drainage Law Passed by the General Assemblies of 1919, 1921, and 1923; compiled by the North Carolina Geological and Economic Survey; April, 1923.

Circular No. 8. North Carolina Drainage Law. (Consolidated Statutes of 1919, with citations of Supreme Court Opinions, and Amendments to date.) Prepared by the North Carolina Geological and Economic Survey; 1923.

FISHERIES AND SEA PRODUCTS

Economic Paper 10. Oyster Culture in North Carolina, by Robert E. Coker, 1905. 8°, 39 pp. *Out of print.*

Economic Paper 12. Investigations Relative to the Shad Fisheries of North Carolina, by John N. Cobb, 1906. 8°, 74 pp., 8 maps. *6 cents.*

Economic Paper 13. Report of Committee on Fisheries in North Carolina. Compiled by Joseph Hyde Pratt, 1906. 8°, 78 pp. *Out of print.*

Economic Paper 14. The Cultivation of the Diamond-back Terrapin, by R. E. Coker, 1906. 8°, 67 pp., 23 pl., 2 figs. *Out of print.*

Economic Paper 15. Experiments in Oyster Culture in Pamlico Sound, North Carolina, by Robert E. Coker, 1907. 8°, 74 pp., 17 pl., 11 figs. *10 cents.*

Economic Paper 16. Report of Convention called by Governor R. B. Glenn to Investigate the Fishing Industries in North Carolina, compiled by Joseph Hyde Pratt, State Geologist, 1908. 8°, 45 pp. *5 cents.*

Economic Paper 24. Fishing Industry of North Carolina, by Joseph Hyde Pratt, 1911. 8°, 44 pp. *5 cents.*

Economic Paper 29. Report of Fisheries Convention held at New Bern, N. C., December 13, 1911, compiled by Joseph Hyde Pratt, State Geologist, together with a Compendium of the Stenographic Notes of the meetings held on the two trips taken by the Legislative Fish Committee appointed by the General Assembly of 1909, and the legislation recommended by this Committee, 1912. 8°, 302 pp. *15 cents.*

Vol. II. Fishes of North Carolina, by H. M. Smith, 1907. 8°, 453 pp., 21 pl., 188 figs. *Cloth-bound copies $2.50.*

GEOLOGY AND PALEONTOLOGY

Bulletin 18. Bibliography of North Carolina Geology, Mineralogy, and Geography, with a list of maps, by Francis Baker Laney and Katherine Hill Wood, 1909. 8°, 428 pp. *25 cents. Cloth-bound, $1.00.*

Vol. I. Corundum and the Basic Magnesian Rocks in Western North Carolina, by Joseph Hyde Pratt and J. Volney Lewis, 1905. 8°, 464 pp., 44 pl., 35 figs. *32 cents. Cloth-bound copy, $1.50 extra.*

Vol. V. The Cretaceous Formations of North Carolina, 1923. 8°, 604 pp., 102 pl., 6 figs. *50 cents. Cloth-bound copies, $1.75.*

Pt. I.—Invertebrates of the Upper Cretaceous Formations, by Lloyd William Stephenson.

Vol. III. The Coastal Plain Deposits of North Carolina, by William Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker, 1912. 8°, 509 pp., 62 pl., 21 figs.

Pt. I.—The Physiography and Geology of the Coastal Plain of North Carolina, by Wm. Bullock Clark, Benjamin L. Miller, and L. W. Stephenson. *25 cents.*

Pt. II.—The Water Resources of the Coastal Plain of North Carolina, by L. W. Stephenson and B. L. Johnson. *25 cents.*

PUBLIC ROADS

Bulletin 4. Road Material and Road Construction in North Carolina, by J. A. Holmes and William Cain, 1893. 8°, 88 pp. *Out of print.*

Economic Paper 2. Recent Road Legislation in North Carolina, by J. A. Holmes. *5 cents.*

Economic Paper 5. Road Laws of North Carolina, by J. A. Holmes. *Out of print.*

Economic Paper 27. Highway Work in North Carolina, containing a Statistical Report of Road Work during 1911, by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1912. 8°, 145 pp., 11 figs. *Out of print.*

Economic Paper 28. Culverts and Small Bridges for County Roads in North Carolina, by C. R. Thomas and T. F. Hickerson, 1912. 8°, 56 pp., 14 figs., 20 pl. *10 cents.*

Economic Paper 30. Proceedings of the Annual Convention of the North Carolina Good Roads Association, held at Charlotte, N. C., August 1 and 2, 1912, in coöperation with the North Carolina Geological and Economic Survey. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1912. 8°, 109 pp. *10 cents.*

Economic Paper 32. Public Roads are Public Necessities, by Joseph Hyde Pratt, State Geologist, 1913. 8°, 62 pp. *5 cents.*

Economic Paper 35. Good Road Days, November 5th and 6th, 1913. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary. 8°, 102 pp., 11 pl. *10 cents.*

Economic Paper 36. Proceedings of the North Carolina Good Roads Association, held at Morehead City, N. C., July 31 and August 1, 1913. In coöperation with the North Carolina Geological and Economic Survey. Statistical Report of Highway Work in North Carolina During 1912. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary. 8°, 127 pp., 7 figs. *Out of print.*

Economic Paper 39. Proceedings of the Good Roads Institute, held at the University of North Carolina, March 17-19, 1914. Held under the auspices of the Departments of Civil and Highway Engineering of the University of North Carolina and the North Carolina Geological and Economic Survey. 8°, 117 pp., 15 figs., 4 pl. *10 cents.*

Economic Paper 43. Proceedings of the Second Road Institute, held at the University of North Carolina, February 23-27, 1915. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1916. 8°, 128 pp. *15 cents.*

Economic Paper 44. Highway Work in North Carolina During the Calendar Year Ending December 31, 1914. Compiled by Joseph Hyde Pratt, State Geologist, and Miss H. M. Berry, Secretary, 1916. 8°, 55 pp. *10 cents.*

GEOLOGY AND TOPOGRAPHY

Map of North Carolina; scale 1-500,000; unmounted. *75 cents.*

Map of North Carolina; scale 1-500,000; mounted on cloth. *$1.50.*

Map of Beaufort County; scale 1-40,000; colored paper. *25 cents.*

Map of Franklin County; scale 1-40,000; colored paper. *25 cents.*

Map of Surry County; blue and white; paper. *25 cents.*

Map of Virgilina District; colored paper; geological. *25 cents.*

Bulletin 27. The Altitudes of North Carolina, 1917. 8°, 124 pp. *20 cents.*

BIENNIAL REPORTS

First Biennial Report, 1891-1892, J. A. Holmes, State Geologist, 1893. 8°, 111 pp., 12 pl., 2 figs. *6 cents.*

Administrative report, giving object and organization of the Survey; Investigations of Iron Ores, Building Stone, Geological work in Coastal Plain Region, including supplies and drinking waters in eastern counties, Report on Forests and Forest Products, Coal and Marble, Investigations of Diamond Drill.

Biennial Report, 1893-1894, J. A. Holmes, State Geologist, 1894. 8°, 15 pp. *1 cent.*

Administrative report.

Biennial Report, 1895-1896, J. A. Holmes, State Geologist, 1896. 8°, 17 pp. *1 cent.*

Administrative report.

Biennial Report, 1897-1898, J. A. Holmes, State Geologist, 1898. 8°, 28 pp. *2 cents.*

Administrative report.

Biennial Report, 1899-1900, J. A. Holmes, State Geologist, 1900. 8°, 20 pp. *2 cents.*

Administrative report.

Biennial Report, 1901-1902, J. A. Holmes, State Geologist, 1902. 8°, 15 pp. *1 cent.*

Administrative report.

Biennial Report, 1903-1904, J. A. Holmes, State Geologist, 1905. 8°, 32 pp. *2 cents.*

Administrative report.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1907. 8°, 60 pp. *3 cents.*

Administrative report; report on certain swamp lands belonging to the State, by W. W. Ashe; it also gives certain magnetic observations at North Carolina stations.

Biennial Report, 1907-1908, Joseph Hyde Pratt, State Geologist, 1908. 8°, 60 pp., 2 pl. *5 cents.*

Administrative report. Contains Special Report on an examination of the Sand Banks along the North Carolina Coast, by Jay F. Bond, Forest Assistant, United States Forest Service; certain magnetic observations at North Carolina stations; Results of an Investigation Relating to Clam Cultivation, by Howard E. Enders, of Purdue University.

Biennial Report, 1909-1910, Joseph Hyde Pratt, State Geologist, 1911. 8°, 152 pp. *10 cents.*

Administrative report, and contains Agreements for coöperation in Statistical Work, and Topographical and Traverse Mapping Work, with the United States Geological Survey; Forest Work, with the United States Department of Agriculture (Forest Service); List of Topographic maps of North Carolina and counties partly or wholly topographically mapped; description of Special Highways in North Carolina; suggested Road Legislation; list of Drainage Districts and Results of Third Annual Drainage Convention; Forestry Reports relating to Connolly Tract, Buncombe County, and Transylvania County State Farms; certain Watersheds; Reforestation of Cut-over and Abandoned Farm Lands on the Woodlands of the Salem Academy and College; Recommendations for the Artificial Regeneration of Longleaf Pine at Pinehurst; Act regulating the use of and for the Protection of Meridian Monuments and Standards of Measure at the several county-seats of North Carolina; list of Magnetic declinations at the county-seats, January 1, 1910; letter of Fish Commissioner of the United States Bureau of Fisheries relating to the condition of the North Carolina fish industries; report of the survey for the North Carolina Fish Commission referring to dutch or pound-net in Albemarle and Croatan sounds and Chowan River, by Gilbert T. Rude, of the United States Coast and Geodetic Survey; Historical Sketch of the several North Carolina Geological Surveys, with list of publications of each.

Biennial Report, 1911-1912, Joseph Hyde Pratt, State Geologist, 1913. 8°, 165 pp. *7 cents.*

Administrative report, and contains reports on method of construction and estimate of cost of road improvement in Stantonsburg Township, Wilson County; report on road conditions in Lee County; report on preliminary location of section of Spartanburg-Hendersonville Highway between Tryon and Tuxedo; report of road work done by United States Office of Public Roads during biennial period; experiments with glutrin on the sand-clay road; report on Central Highway, giving Act establishing and report of trip over the Highway; suggested road legislation; report on the Asheville City watershed; report on the Struan property at Arden, Buncombe County; report on the Woodlands on the farm of Dr. J. W. Kilgore, Iredell County; report on examination of the woodlands on the Berry place, Orange County; report on the forest property of Miss Julia A. Thorns, Asheboro, Randolph County; report on the examination of the forest lands of the Butters Lumber Company, Columbus County; proposed forestry leislation; swamp lands and drainage, giving drainage districts, suggested drainage legislation; proposed Fisheries Commission Bill.

Biennial Report, 1913-1914, Joseph Hyde Pratt, State Geologist, 1915. 8°, 118 pp. *10 cents.*

Administrative report, and contains reports on the work of the State convicts on Hickory Nut Gap Road, Henderson County, and on the link of the Central Highway in Madison County which is being constructed with State convicts; report on road work accomplished by the State Survey and by the United States Office of Public Roads during biennial period; suggested road legislation; a forestry policy for North Carolina; report on investigation; timber supply of North Carolina; reports on the examination of certain forest lands in Halifax County; report on the ash in North Carolina; report on the spruce forests of Mount Mitchell; report on the forest fire conditions in the Northeastern States, by J. S. Holmes. Report on the work of the United States Forest Service in North Carolina in connection with the purchase of forest reserves and their protection; timber tests, including strength of timber, preservation of timber, timber suitable to produce pulp, distillation of certain woods and drying certain woods; suggested forestry legislation; report on the swamp lands and their drainage in North Carolina; suggested drainage legislation; report on magnetic observations made during biennial period; report on the economic value of the fisheries of North Carolina; report on the survey made in Albemarle, Croatan, and Pamlico sounds by the Coast and Geodetic Survey; suggested fisheries legislation.

Biennial Report, 1915-1916, Joseph Hyde Pratt, State Geologist, 1917. 8°, 202 pp. *25 cents.*

Administrative report, and contains special reports on the Protection from Fire of the Forested Watersheds of Navigable Streams; National Forest Reservations; forestry report on Lake Latham Farms near Mebane. N. C.; report on Forest Tract owned by the Cranberry Iron and Coal Company near Cranberry, N. C.; report on work of N. C. Forestry Association; report on Southern Forestry Congress; special report on "The Fisheries of North Carolina"; Magnetic Observations made during 1915 and 1916; Memorial Sketch of Dr. Joseph Austin Holmes.

Biennial Report, 1917-1918, Joseph Hyde Pratt, State Geologist, 1919. 8°, 110 pp. *15 cents.*

Administrative report, and contains special reports on the Mitchell State Park; Proposed Forestry Course at the State University; North Carolina Forestry Association; report on magnetic observations made during biennial period.

Biennial Report, 1919-1920, Joseph Hyde Pratt, Director and State Geologist, 1921. 8°, 74 pp. *10 cents.*

Administrative report.

Biennial Report, 1921-1922, Joseph Hyde Pratt, Director and State Geologist, 1923. 8°, 104 pp. *10 cents.*

Administrative report.

Biennial Report, 1923-1924 (December 1, 1922, to June 30, 1924), Joseph Hyde Pratt, Director and State Geologist; December 1, 1922-March 1, 1924, Brent S. Drane, Director and State Geologist, March 1-June 30, 1924. 8°, 65 pp. *10 cents.*

Administrative report.